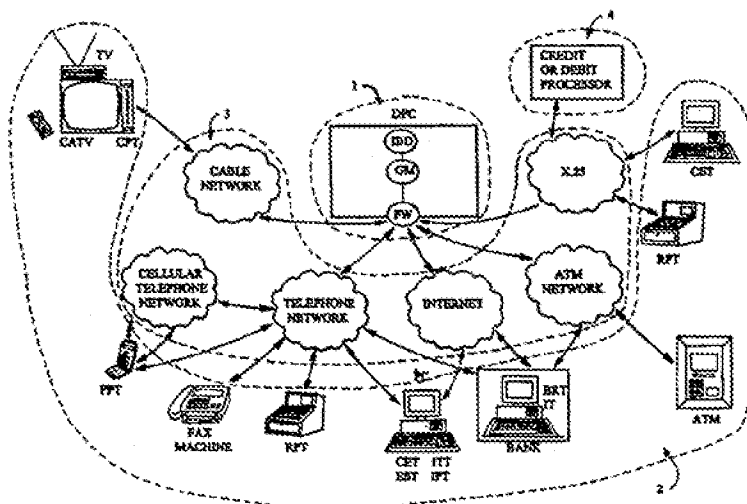




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : <b>G06K 9/00</b>	<b>A1</b>	(11) International Publication Number: <b>WO 96/36934</b> (43) International Publication Date: 21 November 1996 (21.11.96)
(21) International Application Number: PCT/US96/07185 (22) International Filing Date: 17 May 1996 (17.05.96) (30) Priority Data: 08/442,895            17 May 1995 (17.05.95)            US (71) Applicant: SMART TOUCH, L.L.C. [US/US]; Suite 12, 46 Shattuck Square, Berkeley, CA 94704 (US). (72) Inventors: HOFFMAN, Ned; Suite 12, 46 Shattuck Square, Berkeley, CA 94704 (US). PARE, David, F.; Suite 12, 46 Shattuck Square, Berkeley, CA 94704 (US). LEE, Jonathan, A.; Suite 12, 46 Shattuck Square, Berkeley, CA 94704 (US). (74) Agent: KAMAREI, Ali; Suite 12, 46 Shattuck Square, Berkeley, CA 94704 (US).	(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, ES, FI, GB, GE, HU, JP, KE, KG, KP, KR, KZ, LK, LT, LU, LV, MD, MG, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TJ, TT, UA, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i>	

(54) Title: TOKENLESS IDENTIFICATION SYSTEM FOR AUTHORIZATION OF ELECTRONIC TRANSACTIONS AND ELECTRONIC TRANSMISSIONS



## (57) Abstract

A tokenless identification system and method are principally based on a correlative comparison of a unique biometrics sample, such as a finger print or voice recording, gathered directly from the person of an unknown user, with an authenticated biometrics sample of the same type obtained and stored previously (1). It can be networked to act as a full or partial intermediary between other independent computer systems (3), or maybe the sole computer systems carrying out all necessary executions.

**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	GB	United Kingdom	MW	Malawi
AT	Austria	GE	Georgia	MX	Mexico
AU	Australia	GN	Guinea	NE	Niger
BB	Barbados	GR	Greece	NL	Netherlands
BE	Belgium	HU	Hungary	NO	Norway
BF	Burkina Faso	IE	Ireland	NZ	New Zealand
BG	Bulgaria	IT	Italy	PL	Poland
BJ	Benin	JP	Japan	PT	Portugal
BR	Brazil	KE	Kenya	RO	Romania
BY	Belarus	KG	Kyrgyzstan	RU	Russian Federation
CA	Canada	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic	KR	Republic of Korea	SE	Sweden
CG	Congo	KZ	Kazakhstan	SG	Singapore
CH	Switzerland	LI	Liechtenstein	SI	Slovenia
CI	Côte d'Ivoire	LK	Sri Lanka	SK	Slovakia
CM	Cameroon	LR	Liberia	SN	Senegal
CN	China	LT	Lithuania	SZ	Swaziland
CS	Czechoslovakia	LU	Luxembourg	TD	Chad
CZ	Czech Republic	LV	Latvia	TG	Togo
DE	Germany	MC	Monaco	TJ	Tajikistan
DK	Denmark	MD	Republic of Moldova	TT	Trinidad and Tobago
EE	Estonia	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	UG	Uganda
FI	Finland	MN	Mongolia	US	United States of America
FR	France	MR	Mauritania	UZ	Uzbekistan
GA	Gabon			VN	Viet Nam

**TOKENLESS IDENTIFICATION SYSTEM FOR  
AUTHORIZATION OF ELECTRONIC TRANSACTIONS AND  
ELECTRONIC TRANSMISSIONS**

By:

Ned Hoffman

David Pare

Jonathan Lee

**Cross-Reference**

The present application is a continuation-in-part of United States Patent Application Serial No. 08/345,523, filed November 28, 1994, which is incorporated herein by reference.

**Background**

The use of tokens and credit cards in today's financial world is pervasive. A token would be any inanimate object which confers a capability to the individual presenting the object. Remote access of every financial account is through the use of tokens or plastic cards. Whether buying groceries with debit cards or consumer goods with credit cards, at the heart of that transaction is a money transfer enabled by a token, which acts to identify an individual and the financial account he is accessing.

The reason for the migration from metal coins to plastic cards is simple and straightforward: access to money in this money transfer system is vastly safer and more convenient for both merchants and consumers than handling large quantities of coins and notes.

Unfortunately, current technology in combination with this convenient token-based money transfer system results in a system that is prone to theft and fraud.

As verification of user identity is based solely on data placed on the token, which can be easily reproduced and transferred between individuals, such security must rely on both the diligence and the luck of the authorized user and merchant in maintaining this information as proprietary. However, by their very nature, tokens do not have a very strong connection with the individual. Identification of the rightful owner of the token through the token is tenuous at best. This is easily

demonstrated by the fact that individuals other than the rightful owners of the tokens have been using these tokens to defraud merchants and other consumer goods suppliers.

5 The mammoth expansion of the consumer credit industry during the 1980s brought with it large profits for issuers, and newfound convenience for consumers. However, as consumer credit became easier for consumers to acquire, it also became a target for criminals. Much as the mobility of the automobile led to a rash of bank robberies in the late 1920's and early 1930's, so too did the ubiquity of consumer credit lead to vastly increased opportunities for criminals.

10 Initially, the banking industry was willing to accept a certain amount of loss due to fraud, passing the cost on to the consumer. However, as criminals became more organized, more technically adept, and as credit retail stations began to be manned by people who were more and more poorly trained in credit card security matters, the rate of increase of fraud losses skyrocketed. The staggering statistics on fraud and cost of preventive steps, has forced the credit card companies in particular, to look for other solutions to the problem.

15 Fraud losses in the credit card industry stem from many different areas due to the highly vulnerable nature of the system, but they are mainly due to either lost, stolen, or counterfeit cards. Credit cards operate without the use of a personal identification code (PIC), therefore a lost credit card can be turned into cash if the card falls into the wrong hands. While theft of a token constitutes the majority of fraud in the system, the use of counterfeit credit cards has been on the rise. Counterfeit credit cards are manufactured by a more technically sophisticated criminal by acquiring a cardholder's valid account number and then producing a counterfeit card using that valid number. The counterfeiter encodes the magnetic strip, and embosses the counterfeit plastic card with the account number. The card is then presented to merchants and charged up to the 20 rightful cardholder's account. Another form of loss is by a criminal merchant who surreptitiously obtains the cardholder's account number. Yet another type of fraud is committed by the authorized cardholder when the token is used for making purchases and thereafter a claim is made that the token was either lost or stolen. It is estimated that losses due to all types of fraud exceeds \$950 million dollars annually.

Generally, debit cards are used in conjunction with a personal identification code (PIC). Counterfeiting a debit card is more difficult as the criminal must acquire not only the account number, but also the PIC, and then manufacture the card as in the credit card example. However, various strategies have been used to obtain PICs from unwary cardholders; these range from Trojan horse automated teller machines, or ATMs, in shopping malls that dispense cash but record the PIC, to merchant point of sale devices that also record the PIC, to individuals with binoculars that watch cardholders enter PICs at ATMs. The subsequently manufactured counterfeit debit cards are then used in various ATM machines until the unlucky account is emptied.

The financial industry is well aware of the trends in fraud expense, and is constantly taking steps to improve the security of the card. Thus fraud and theft of token have an indirect impact on the cost to the system.

Card blanks are manufactured under very tight security. Then they are individualized with the account number, expiration date, and are then mailed to the cardholder. Manufacturing and distributing the card alone costs the industry approximately one billion dollars annually. The standard card costs the financial industry \$2 for each, but only \$0.30 of this \$2 is associated with actual manufacturing cost.

Over the last ten years, the industry has altered the tokens because of counterfeiting fraud, without any fundamental changes in the use of the credit transaction system. The remedy has been mostly administrative changes such as having customers call the issuer to activate their card. Other changes include addition of a hologram, a picture ID, or an improved signature area. These type of changes in particular, are an indication that the systems susceptibility to fraud is due to lack of true identification of the individual. It is estimated that this could double the manufacturing cost to two billion dollars annually.

In the near future, the banking industry expects to move to an even more expensive card, called a "smart card". Smart cards contain as much computing power as did some of the first home computers. Current cost projections for a first-generation smart card is estimated at approximately \$3.50, not including distribution costs, which is significantly higher than the \$0.30 plastic card blank.

5 This significant increase in cost has forced the industry to look for new ways of using the power in the smart card in addition to simple transaction authorization. It is envisioned that in addition to storing credit and debit account numbers, smart cards may also store phone numbers, frequent flyer miles, coupons obtained from stores, a transaction history, electronic cash usable at tollbooths and on public transit systems, as well as the customer's name, vital statistics, and perhaps even medical records. Clearly, the financial industry trend is to further establish use of tokens.

10 The side effect of increasing the capabilities of the smart card is centralization of functions. The flip side of increased functionality is increased vulnerability. Given the number of functions that the smart card will be performing, the loss or damage of this monster card will be excruciatingly inconvenient for the cardholder. Being without such a card will financially incapacitate the cardholder until it is replaced. Additionally, 15 losing a card full of electronic cash will also result in a real financial loss as well. Furthermore, ability of counterfeiters to one day copy a smartcard is not addressed.

20 Unfortunately, because of the projected concentration of functions onto the smart card, the cardholder is left more vulnerable to the loss or destruction of the card itself. Thus, after spending vast sums of money, the resulting system will be more secure, but threatens to levy heavier and heavier penalties for destruction or loss of this card on the consumer.

25 The financial industry recognizes the security issues associated with smartcards, and efforts are currently underway to make each plastic card difficult to counterfeit. Billions of dollars will be spent in the next five years in attempts to make plastic ever more secure. To date, the consumer financial transaction industry has had a simple equation to balance: in order 30 to reduce fraud, the cost of the card must increase.

35 In addition to and associated with the pervasiveness of electronic financial transactions, there is now the widespread use of electronic facsimiles, electronic mail messages and similar electronic communications. Similar to the problem of lack of proper identification of individuals for financial transactions is the problem of lack of proper identification of individuals for electronic transmissions. The ease and

speed of electronic communication, and its low cost compared to conventional mail, has made it a method of choice for communication between individuals and businesses alike. This type of communication has expanded greatly and is expected to continue to expand. However, millions of electronic messages such as facsimiles and electronic mail (or "E-mail" or "email") messages are sent without knowing whether they arrive at their true destination or whether a certain individual actually sent or received that electronic message. Furthermore, there is no way to verify the identify the individual who sent or who received an electronic message.

Recently, various attempts have been made to overcome problems inherent in the token and code security system. One major focus has been to encrypt, variablize or otherwise modify the PIC to make it more difficult for an unauthorized user to carry out more than one transaction, largely by focusing on manipulation of the PIC to make such code more fraud resistant. A variety of approaches have been suggested, such as introducing an algorithm that varies the PIC in a predictable way known only to the user, thereby requiring a different PIC code for each subsequent accessing of an account. For example, the PIC code can be varied and made specific to the calendar day or date of the access attempt. In yet another approach, a time-variable element is introduced to generate a non-predictable personal identification code that is revealed only to an authorized user at the time of access. Although more resistant to fraud than systems incorporating non-variable codes, such an approach is not virtually fraud-proof because it still relies on data that is not uniquely and irreproducibly personal to the authorized user. Furthermore, such systems further inconvenience consumers that already have trouble remembering constant codes, much less variable ones. Examples of these approaches are disclosed in United States Patents 4,837,422 to Dethloff et al.; 4,998,279 to Weiss; 5,168,520 to Weiss; 5,251,259 to Mosley; 5,239,538 to Parrillo; 5,276,314 to Martino et al.; and 5,343,529 to Goldfine et al. all of which are incorporated herein by reference.

More recently, some have turned their attention from the use of personal identification codes to the use of unique biometrics as the basis of identity verification, and ultimately computer access. In this approach, authenticated biometrics are recorded from a user of known identity and stored for future reference on a token. In every subsequent access attempt,

the user is required to enter physically the requested biometrics, which are then compared to the authenticated biometrics on the token to determine if the two match in order to verify user identity. Because the biometrics are uniquely personal to the user and because the act of physically entering the biometrics are virtually irreproducible, a match is putative of actual identity, thereby decreasing the risk of fraud. Various biometrics have been suggested, such as finger prints, hand prints, voice prints, retinal images, handwriting samples and the like. However, because the biometrics are generally stored in electronic (and thus reproducible) form on a token and because the comparison and verification process is not isolated from the hardware and software directly used by the individual attempting access, a significant risk of fraudulent access still exists. Examples of this approach to system security are described in United States Patents 4,821,118 to Lafreniere; 4,993,068 to Piosenka et al.; 4,995,086 to Lilley et al.; 5,054,089 to Uchida et al.; 5,095,194 to Barbanell; 5,109,427 to Yang; 5,109,428 to Igaki et al.; 5,144,680 to Kobayashi et al.; 5,146,102 to Higuchi et al.; 5,180,901 to Hiramatsu; 5,210,588 to Lee; 5,210,797 to Usui et al.; 5,222,152 to Fishbine et al.; 5,230,025 to Fishbine et al.; 5,241,606 to Horie; 5,265,162 to Bush et al.; 5,321,242 to Heath, Jr.; 5,325,442 to Knapp; 5,351,303 to Willmore, all of which are incorporated herein by reference.

As will be appreciated from the foregoing discussion, a dynamic but unavoidable tension arises in attempting to design a security system that is highly fraud resistant, but nevertheless easy and convenient for the consumer to use. Unfortunately, none of the above-disclosed proposed improvements to the token and code system adequately address, much less attempt to balance, this tension. Such systems generally store the authenticated biometrics in electronic form directly on the token that can presumably be copied. Further, such systems do not adequately isolate the identity verification process from tampering by someone attempting to gain unauthorized access.

An example of token-based security system which relies on a biometrics of a user can be found in United States Patent 5,280,527 to Gullman et al. In Gullman's system, the user must carry and present a credit card sized token (referred to as a biometrics security apparatus) containing a microchip in which is recorded characteristics of the



authorized user's voice. In order to initiate the access procedure, the user must insert the token into a terminal such as an ATM, and then speak into the terminal to provide a biometrics input for comparison with an authenticated input stored in the microchip of the presented token. The process of identity verification is generally not isolated from potential tampering by one attempting unauthorized access. If a match is found, the remote terminal may then signal the host computer that access should be permitted, or may prompt the user for an additional code, such as a PIN (also stored on the token), before sending the necessary verification signal to the host computer.

Although Gullman's reliance of comparison of stored and input biometrics potentially reduces the risk of unauthorized access as compared to numeric codes, Gullman's use of the token as the repository for the authenticating data combined with Gullman's failure to isolate the identity verification process from the possibility of tampering greatly diminishes any improvement to fraud resistance resulting from the replacement of a numeric code with a biometrics. Further, the system remains somewhat cumbersome and inconvenient to use because it too requires the presentation of a token in order to initiate an access request.

Almost uniformly, patents that disclose token-based systems teach away from biometrics recognition without the use of tokens. Reasons cited for such teachings range from storage requirements for biometrics recognition systems to significant time lapses in identification of a large number of individuals, even for the most powerful computers.

In view of the foregoing, there has long been a need for a computer access system that is highly fraud-resistant, practical, and efficient for the user to operate and carry out electronic transactions and transmissions expeditiously.

There is also a need for a computer system that is completely tokenless and that is capable of verifying a user's personal identity, based solely upon a personal identification code and biometrics that is unique and physically personal to an authorized user, as opposed to verifying an individual's possession of any physical objects that can be freely transferred between different individuals. Such biometrics must be easily and non-intrusively obtained; must be easy and cost-effective to store and to analyze; and must not unduly invade the user's privacy rights.

5 A further need in computer access system design is user convenience. It is highly desirable for a consumer to be able to access the system spontaneously, particularly when unexpected needs arise, with a minimum of effort. In particular, there is a need for a system that greatly reduces or eliminates the need to memorize numerous or cumbersome codes, and that eliminates the need to possess, carry, and present a proprietary object in order to initiate an access request.

10 Such systems must be simple to operate, accurate and reliable. There is also a need for a computer access system that can allow a user to access multiple accounts and procure all services authorized to the user, and carry out transactions in and between all financial accounts, make point of purchase payments, receive various services, etc.

15 There is further a great need for a computer access system that affords an authorized user the ability to alert authorities that a third party is coercing the user to request access without the third party being aware that an alert has been generated. There is also a need for a system that is nevertheless able to effect, unknown to the coercing third party, temporary restrictions on the types and amounts of transactions that can be undertaken once access is granted.

20 Furthermore, the computer system must be affordable and flexible enough to be operatively compatible with existing networks having a variety of electronic transaction and transmission devices and system configurations.

25 Finally, there is a need for secured sending and receipt of electronic mail messages and electronic facsimiles, where content of the electronic message is protected from disclosure to unauthorized individuals, and the identity of the sender or recipient can be obtained with a high degree of certainty.

### 30 Summary of the Invention

35 The present invention satisfies these needs by providing an improved identification system for determining an individual's identity from a comparison of an individual's biometrics sample and personal identification code gathered during a bid step with biometrics sample and personal identification code for that individual gathered during a registration step and stored at a remote site wherein there is a data

processing center. The invention comprises a computer network host system with means for comparing the entered biometrics sample and personal identification code, and is equipped with various data bases and memory modules. Furthermore, the invention is provided with biometrics and personal identification code input apparatus and terminals for entering data to provide information for execution of the requested transactions and transmissions by the host system once the identity of the individual is determined. The invention is also provided with means for connecting the host system with the terminal and the biometrics input apparatus.

The computer also has means for execution of various transactions and transmission in addition to traditional storing of and modification of data. Additionally, the computer can output the evaluation of the biometrics- PIC ("personal identification code") comparison, and the determination of an identification evaluation, or status of any execution of transactions or transmissions. Furthermore, the computer system notifies and authenticates to the individual being identified that the computer system was accessed, by returning to the individual a private code which was previously selected by that individual during the registration step.

Preferably, the computer system is protected from electronic eavesdropping and electronic intrusion and viruses. Further, the devices used by the computer for gathering biometric samples and personal identification codes would comprise: a) at least one biometric input device for gathering biometric samples, which would have a hardware and a software component; b) at least one terminal device that is functionally partially or fully integrated with the biometric input means for input of and appending ancillary information; c) at least one data entry device for input of a personal identification code whereby this data entry device is integrated either with the biometric input device or the terminal device; and, d) a means for interconnecting the biometric input device, data entry device and the terminal. The terminal device also has at least one display device for displaying data and information. For additional security the computer system uniquely identifies the biometric input apparatus, and the counter party or merchant through a counter party or merchant identification code relating to the terminal that is connected to the biometric input device. It is also preferred that the biometric input apparatus be secured from physical and electronic tampering, and that in

case of physical breach of the device, means be employed to physically and/or electronically destroy components within the apparatus and/or erase critical data from the device's memory modules.

In addition, the biometric input apparatus would have a hardware component comprising: a) at least one computing module for data processing; b) erasable and non-erasable memory modules for storage of data and software; c) a biometric scanner device for input of biometric data; d) a data entry device for entering data; e) a digital communications port; f) a device for prevention of electronic eavesdropping.

In order to protect the integrity and confidentiality of electronic data sent between the biometric input apparatus, the terminal, and the computer network, it is preferred that the data be encrypted and sealed.

The host computer network is also connected to and is able to communicate with other independent computer systems, databases, facsimile machines, and other computer networks through conventional means.

The method of the present invention includes voluntarily identifying an individual without the use of any tokens by means of examination of at least one biometrics sample provided by that the individual and a personal identification code also provided by that individual. During a registration step, the individual is to register with the system an authenticated biometric sample, a personal identification code and a private code. Thereafter, during a bid step the biometrics sample and personal identification code of the individual is gathered and compared to the ones registered during the registration step. A match of the personal identification codes and biometrics sample will result in the positive identification of the individual. In order to authenticate to the identified individual that the real computer system was accessed, the individual's private code, which was collected at the registration step, is returned to the individual.

It is preferred that the method of the invention include a method for examining the biometrics samples during registration and comparing such biometrics with a collection of biometrics samples from individuals who have been designated as having previously attempted to perpetrate or who have actually perpetrated fraud upon the system.

In a preferred embodiment, the invention includes a method for notifying authorities of the presence of exigent circumstances or that the authorized user is under duress.

It is also preferred that a method of encryption and sealing of data be used to protect the data, including the digitized biometrics sample, from being revealed accidentally or unveiled from criminal elements during transmission.

It is also preferred that the method include steps for the individual to choose various financial accounts, and choose various modes of electronic transmissions.

It is also preferred that the method include a method for archiving of data and electronic transmissions, and retrieval of the archived data using a tracking code.

It is furthermore preferred that any document, such as a facsimile or an electronic mail message be uniquely checksummed using algorithm for future identification of the document.

Yet another method of the invention is to be able to rapidly identify an individual from an examination of his biometrics sample and personal identification code by storing several dissimilar biometrics samples from different individuals in an electronic basket that is identified by one personal identification code.

In one embodiment of the invention, the computer system can allow individuals to select their own personal identification code (or "PIC") from a group of PICs selected by the remote data processing center. This is performed in a method whereby once the individual's biometric is gathered, the data processing center selects several PICs at random which may be conducive to being memorized. The data processing center then conducts a comparison of the biometric gathered with those already in those PIC baskets or groups. In the event the new registrant's biometric is too similar to any previously registered biometric which has been allotted to any one of those randomly selected PIC groups, then that PIC is rejected by the database for use by the new individual and an alternative PIC is selected for another such biometric comparison. Once the data processing center has generated several PIC options without a confusingly similar biometric, those PICs are presented to the new registrant from which the individual may select one PIC.

In one embodiment of the invention, there is a method for rapid search of at least one first previously stored biometric sample from a first individual, using a personal identification code-basket that is capable of containing at least one algorithmically unique second biometric sample that is from at least one second individual, and which is identified by said personal identification code-basket, comprising, firstly, a storage step further comprising: a) the selection of a private code by a first individual; b) the selection of a personal identification code by said first individual; c) the entering a biometric sample from said first individual; d) locating the personal identification code-basket identified by the personal identification code selected by said first individual; e) comparison of the biometric sample taken from said first individual with any previously stored biometric samples in said selected personal identification code-basket to make sure that the biometric sample entered by said first individual is algorithmically unique from the previously stored at least one biometric sample provided by at least one second individual, and; f) storage of the entered biometric sample from said first individual in the selected personal identification code-basket if said sample is algorithmically unique from the at least one previously stored biometric sample from said at least one second individual. There is also a bid step further comprising: a) entering said selected personal identification code by said first individual, and; b) entering a biometric sample by said first individual. There is also a comparison step comprising: a) finding the personal identification code-basket that is identified by said personal identification code entered by said first individual, and; b) comparison of the entered biometric sample from said first individual with said at least one stored biometric sample from said at least one second individual in said entered personal identification code-basket for producing either a successful or failed identification result. There could also be: a) an execution step wherein a command is processed and executed to produce a determination; b) an output step wherein said identification result or said determination is externalized and displayed, and; c) a presentation step wherein on successful identification of said first individual, said private code is presented to said first individual.

According to one embodiment of the invention, the host system is positioned in series between the individual being identified and other computer networks that are to be accessed, thereby acting as an interface. It will be appreciated that in this embodiment, the user tenders an access request directly to the host computer system of the invention, which is operationally interactive with other independent secured computer systems such as VISANET. The computer system would therefore maintain authenticated biometrics data samples for all authorized users of each secured computer system that it services. These data would be cross-referenced by each authorized user. Thus, after identity verification is completed, the security system provides to the user a listing of systems that he is authorized to access, and prompts the user to select the desired network. Thereafter, the requested execution step and information regarding the transaction is forwarded to the selected independent computer network similar to the type of communications sent today between merchants and credit card companies.

In a second embodiment the host system may also carry out the functions of the other independent computer systems such as debiting or crediting a financial account. In this system, the computer system of the invention carries out the functions requested by the individual without use of external, independent computer networks.

According to a further embodiment of the invention, a means is provided for alerting predesignated authorities during an access attempt during which the user has been coerced by a third party to request access to the host computer system. In such an embodiment, an authorized user would have a number of codes, most of which would be recognized by the computer system as the standard access codes, and others which would be recognized as emergency codes. The comparison means of the computer system of the invention would be configured to accept and recognize at least one code per authorized user, and to activate the emergency alert means whenever the code entered by the user matched an emergency code. At the same time, the determination of an authorized identity for the user would result in the user being afforded access to the requested secured computer system perhaps on an access level that has been predetermined to be restricted or perhaps resulting in the display of misleading data (i.e., "false screens"), thereby preventing the coercing third party from knowing

that an emergency notification had been entered by the user. The emergency code would be entered as a part of or simultaneously with the user's personal identification code or by selecting an emergency account index during the access of the computer system. In either case, the well-being of the user requesting access might be jeopardized if the coercing party discovered that the user was attempting to notify authorities. Thus, it is critical that the access procedure continue uninterruptedly and that access be granted to an authorized user so that the coercing party believes that everything is proceeding normally. Although these features can be incorporated into the invention's host computer network, it is also possible that an independent computer network can also carry out the same or modified versions of the above-mentioned features.

The present invention is clearly advantageous over the prior art in a number of ways. First, it is extremely easy and efficient for the user, particularly where the user is accessing financial accounts, because it eliminates the need to carry and present any tokens in order to access one's accounts. The present invention eliminates all the inconveniences associated with carrying, safeguarding and locating any desired tokens. Further, because tokens are often specific to a particular computer system that further requires remembering a secret code assigned to the particular token, this invention eliminates all such tokens and thereby significantly reduces the amount of memorization and diligence increasingly required of consumers by providing access to all assets using only one personal identification code. Thus, in a single, tokenless transaction, the consumer can efficiently and securely conduct virtually any commercial exchange or electronic message, from withdrawing cash from a bank account, to authorization his agreement to the terms of a contract, to making a purchase directly from television, to paying local property taxes. The consumer is now uniquely empowered, by means of this invention, to conveniently conduct his personal and/or professional electronic transmissions and transactions at any time without dependence upon tokens which may be stolen, lost or damaged.

The invention is clearly advantageous from a convenience standpoint to retailers and financial institutions by making purchases and other financial transactions less cumbersome and more spontaneous. The paper work of financial transactions is significantly reduced as compared to



current systems, such as credit card purchase wherein separate receipts are generated for use by the credit card company, the merchant and the consumer. Such electronic transactions also save merchants and banks considerable time and expense by greatly reducing operational costs. Because the system of the invention is designed to provide a consumer with simultaneous direct access to all of his financial accounts, the need for transactions involving money, checks, commercial paper and the like will be greatly reduced, thereby reducing the cost of equipment and staff required to collect and account for such transactions. Further, the substantial manufacturing and distributing costs of issuing and reissuing credit cards, ATM cards, calling cards and the like will be eliminated, thereby providing further economic savings to merchants, banks, and ultimately to consumers. In fact, the system of the invention will likely spur economic growth since all of a consumer's electronic financial resources will be available at the mere input of his fingerprint or other biometrics.

The invention is markedly advantageous and superior to existing systems in being highly fraud resistant. As discussed above, present computer systems are inherently unreliable because they base determination of a user's identity on the physical presentation of a unique manufactured object along with, in some cases, information that the user knows. Unfortunately, both the token and information can be transferred to another, through loss, theft or by voluntary action of the authorized user. Thus, unless the loss or unintended transfer of these items is realized and reported by the authorized user, anyone possessing such items will be recognized by existing security systems as the authorized user to whom that token and information is assigned.

By contrast, the present invention virtually eliminates the risk of granting access to non-authorized users by determining user identity from an analysis of one or more of a user's unique, biometrics characteristics. Even in the very rare circumstance of coercion, where an authorized individual is coerced by a coercing party to access his accounts, the system anticipates an emergency account index, whereby the authorized user can alert authorities of the transgression without the knowledge of the coercing party.

The invention further enhances fraud resistance by maintaining authenticating data and carrying out the identity verification operations at a point in the system that is operationally isolated from the user requesting access, thereby preventing the user from acquiring copies of the authenticating data or from tampering with the verification process. Such a system is clearly superior to existing token-based systems wherein authenticating information, such as personal codes, is stored on and can be recovered from the token, and wherein the actual identity determination is potentially in operational contact with the user during the access process.

It is an object of the invention therefore to provide a computer access identification system that eliminates the need for a user to possess and present a physical object, such as a token, in order to initiate a system access request.

It is another object of the invention to provide a computer access identification system that is capable of verifying a user's identity, as opposed to verifying possession of proprietary objects and information.

It is yet another object of the invention to verify user identity based upon one or more unique characteristics physically personal to the user.

Yet another object of the invention is to provide a system of secured access that is practical, convenient, and easy use.

Still another object of the invention is to provide a system of secured access to a computer system that is highly resistant to fraudulent access attempts by non-authorized users.

Yet another object of the invention is to provide a computer access identification system that enables a user to notify authorities that a particular access request is being coerced by a third party without giving notice to said third party of the notification.

There is also a need for a computer access identification system that automatically restricts a user's transactional capabilities on the computer system according a desired configuration provided by the user.

These and other advantages of the invention will become more fully apparent when the following detailed description of the invention is read in conjunction with the accompanying drawings.

### Brief Description of the Drawings

FIG. 1 is a diagram of the system of the present invention;

FIG. 2 is a diagram of the Data Processing Center (DPC) and its internal data bases and execution modules;

FIG. 3 is a diagram of the retail point of sale terminal, the biometrics input apparatus and its components, and the interconnections between them;

FIG. 4 is a flow chart of the operation of the biometrics input apparatus and the terminal for generating a request packet;

FIG. 5 is a representational diagram of the request packet and the mandatory and optional data it contains;

FIG. 6 is a representational diagram of the response packet and the mandatory and optional data it contains;

FIG. 7 is a flow chart depicting the data encryption and sealing process at the biometrics input device;

FIG. 8 is a flow chart depicting the data decryption and counter party identification process at the DPC;

FIG. 9 is a flow chart depicting the data encryption and sealing process at the DPC;

FIG. 10 is a flow chart representing the registration of an individual during the registration process;

FIG. 11 is a flow chart representing the process of identification of the individual and returning a private code to the individual;

FIG. 12 is a flow chart of the skeleton of the processes that occur at the DPC and an execution step;

FIG. 13 is a flow chart of the emergency request and response process at the DPC;

FIG. 14 is a flow chart of the overall operation of retail transaction authorization execution at the DPC;

FIG. 15 is a flow chart of the overall operation of remote transaction authorization execution step at the DPC;

FIG. 16 is a flow chart of the overall operation of ATM account access execution at the DPC;

FIG. 17 is a flow chart of the overall operation of issuer batch modification execution at the DPC;

FIG. 18 is a flow chart of the overall operation of secure fax submit and electronic document submit execution at the DPC;

FIG. 19 is a flow chart of the overall operation of secure fax data and electronic document data execution at the DPC;

FIG. 20A is a representational diagram of the electronic signature request packet;

FIG. 20B is a representational diagram of the electronic signature response packet;

FIG. 20C is a representational diagram of the electronic signature verification request packet;

FIG. 20D is a representational diagram of the electronic signature verification request packet;

FIG. 21 is a flow chart of the overall operation of electronic signature execution at the DPC; and

FIG. 22 is a flow chart of the overall operation of electronic signature verification execution at the DPC.

### Detailed Description of the Drawings

As noted, the main objective of this invention is to provide a tokenless, secure, reliable, safe, and consistent, apparatus and method, for identifying individuals for the purpose of performing financial transactions and non-financial transmissions, which can accommodate large numbers of users. It is the essence of this invention that consumers have the ability to conduct these transactions without the use of any tokens, credit cards, badges or identification cards including drivers licenses. In order to be functional it is important that the system operate at speeds required for completing financial transactions such as credit card purchases and ATM services, from multiple banks and credit accounts. The system must be secure, such that individuals records and their biometrics information remain confidential and safe, both within the computer system that identifies the individual and authorizes transactions, or during transfer of data between the computer system and remote sites with which the computer system communicates. Furthermore, the system must be reliable

in that errors in identification and authorization must not hamper or make use of the system cumbersome. Since only the use of biometrics are contemplated for identification of individuals, the system must also have security measures to either reduce access, even to the authorized user, or notify authorities in emergency cases. It is appreciated that the system must be able to handle a large number of users, and accommodate storage and transfer of large amounts of data, such as bio-characteristic information, commensurate with speeds at which financial transactions are carried on today.

Turning now to the figures, the overall configuration of the invention and its components are shown in FIG. 1. Essentially a Data Processing Center (DPC) 1 is connected to various terminals 2 through various type of communication means 3 which can be one of several types. The DPC is also connected and communicates with independent computer networks 4. The DPC contains several data bases and software execution modules as shown in FIG. 2. In a preferred embodiment of the invention, the data bases are backed up or "mirrored" for safety reasons. The Firewall Machine 5 is responsible for prevention of electronic intrusion of the system while the Gateway Machine 6 is responsible for carrying out all requests from the user, including adding, deleting and otherwise modifying all data bases. The Gateway Machine is also responsible for decryption and de-packaging of data that has arrived from the terminals using the MACM module 7, MDM module 8, and the SNM module 9. The PGL module 10, and the IML module 11 are used to locate the proper personal identification code and biometrics sample basket. FIG. 3 depicts an example of a terminal and the biometrics input device 12, which has a biometrics scanner 13, data entry means such as a key pad or PIN pad 14, and a display panel 15. The biometrics scanner can be any one of finger print scanner, voice recognition, palm print scanner, retinal scanner or the like, although the fingerprint scanner will be used as an example. The biometrics input device is further equipped with computing modules 16, device drivers, and erasable and non-erasable memory modules. The biometrics input device communicates with the terminal through preferably a serial port 17. The terminal 2 communicates through a conventional modem 18 with the DPC 1 through request packets 19 and response packets 20 using one of the interconnecting means in FIG. 1 such as cable

network, cellular telephone networks, telephone networks, Internet, ATM network, or X.25. FIG. 4 shows a representational diagram of the request packet 19 and its method of generation by the biometrics input device software. FIG. 5 and FIG. 6 show a representational diagram of the request packet and response packet with optional and mandatory data segments. Furthermore, it is shown which parts of the packets are encrypted and which ones are sealed. FIG. 7 is a block diagram of the overall process for data encryption and sealing showing the use of DUKPT key data 20 for encryption of data before appending additional data before sealing the request packet with a Message Authentication Code Key (MAC) 21. FIG. 8 and FIG. 9 show the decryption and encryption process at the DPC. FIG. 12 through 19 and 21 through 22 are block diagrams of selected examples of execution steps carried on at the DPC.

Description of the drawings, diagrams, flow charts and the description of the invention, including hardware components, software components, execution modules, data bases, connection means, the data transferred between them, and the method of the invention is described in detail as follows.

## 1.1. Biometric Input Apparatus (BIA)

### 1.1.1. Introduction

The BIA is a combination of hardware and software whose job is to gather, encode, and encrypt biometric input for use in individual identification. All actions of the BIA are directed by an outside controlling entity called a terminal, which issues commands and receives results over the BIA's serial line.

BIA hardware comes in four basic versions: standard, wireless, integrated phone/cable television (or "CATV")/fax, and ATM. Each BIA hardware variant addresses a particular need in the marketplace, and because of the differences in construction, each variant has a different level of security.

BIA software comes in seven basic versions: personal computer (or "PC"), retail, ATM, registration, internal, issuer, and integrated remote. Each software load provides a different, use-specific command set. For

instance, the registration software load does not accept requests to form retail transaction messages. Likewise, the retail software command set cannot send individual registration messages. To provide another layer of security, the DPC knows what software package is loaded into each BIA; any attempts by an BIA to send a message that it is normally not able to send is rejected, and treated as a major security violation.

The ability of the invention to detect and combat merchant-based fraud relies on the fact that the BIA's external interface is strictly limited, that the construction of the BIA makes it extremely difficult to tamper with the contents, that each BIA has its unique encryption codes that are known only to the DPC, and that each BIA is only allowed to perform operations limited to its designated function. Each biometric input means has a hardware identification code previously registered with the DPC, which makes the biometric input means uniquely identifiable to the DPC in each subsequent transmission from that biometric input device.

The BIA is constructed with the assumption that the controlling terminal is a source for fraud and deception. Terminals range from software applications running on personal computers to dedicated hardware/software systems developed for a particular use such as a retail point of sale. Regardless of the particular model, no BIA reveals unencrypted biometric information. BIA models without display means (such as LCD, LED, or quartz screens) must reveal selected information (such as individual private codes) to the terminal for display, and as a result those particular terminal-BIA combinations are considered to be less secure.

Depending on the task at hand, BIA models are either partially or fully integrated with the terminal. Partially integrated devices are physically separate from the terminal, and they include wireless and standard retail point of sale BIAs. Fully integrated devices are contained within the physical enclosure of the terminal itself, for instance, an ATM, or a telephone.

No BIA ever discloses any secret encryption codes to any external source.

### 1.1.2. BIA Models

Particular BIA hardware models have different configurations. They are introduced in brief here:

#### BIA

Standard model has computing module (i.e., multichip modules), biometric scanner (i.e., single fingerprint scanner), display means (i.e., LCD screen), communications port (i.e., serial port), data entry means (i.e., a manual data entry key board or PIC pad) encased in tamper-resistant case, and electronic detection means (i.e., RF shielding).

#### BIA/Wireless

Standard model, but serial line replaced with spread-spectrum wireless communications module using external antenna. Used in restaurant point of sale.

#### BIA/ATM

Has heavy-duty scanner and serial port, along with a multichip module. The fact that the LCD is part of the terminal and not the BIA means lower security because it must reveal the private code to the terminal. Used in ATMs.

#### BIA/Catv

Has light-duty scanner, otherwise like ATM. Used in telephones, CATV remotes, and fax machines. Weakest security, both because the LCD and PIC pad are part of the terminal not the BIA, and because of the low-cost nature of the market.

### 1.1.3. BIA Command Set Messages

Each BIA software command set provides a different set of operations. They are introduced briefly here:

#### BIA/ATM

Account Access



**BIA/Catv**

Remote Transaction Authorization

**BIA/Fax**

Secure Fax Submit

Secure Fax Data

Secure Fax Tracking

Secure Fax Retrieve

Secure Fax Reject

Secure Fax Archive

Secure Fax Contract Accept

Secure Fax Contract Reject

Electronic Document Archive Retrieve

**BIA/Internal**

Individual Identification

**BIA/Issuer**

Issuer Batch

**BIA/PC**

Electronic Document Submit

Electronic Document Data

Electronic Document Tracking

Electronic Document Retrieve

Electronic Document Reject

Electronic Document Archive

Electronic Document Archive Retrieve

Electronic Signature Submission

Electronic Signature Check

Remote Transaction Authorization

Network Credential

Secured Connection

**BIA/Registration**

Individual Identification

Biometric Registration

5

**BIA/Retail**

Transaction Authorization

**1.1.4. BIA Hardware: Standard Model**

10

The Standard BIA hardware is a multichip module combined with a single-print scanner, an LCD screen, a serial port, and a PIC pad encased in a hard tamper-resistant case that makes attempts to penetrate obvious while also providing RF shielding for the contents.

15

The following components are amalgamated into a multichip module, called the BIA Multichip Module (a process for encapsulating several processors in one physical shell, well known in the industry), constructed to protect the communications pathways between the devices from easy wiretapping.

20

- Serial processor
- PIC pad processor
- LCD screen processor
- CCD scanner A/D processor
- High-speed DSP processor containing both flash and mask ROM
- General purpose microprocessor
- Standard RAM
- EEPROM

25

30

The following software packages and data are stored in mask ROM. Mask ROM is cheaper than other types of read only memory, but it is easily reverse engineered, and is not electronically erasable. As such we only place the noncritical commonly available code here. (Mask ROM is well known in the industry).

35

- MAC calculation library
- DUKPT Key Management library
- DES (with CBC) Encryption library
- Base-64 (8-bit to printable ASCII) converter library
- Public Key Encryption library
- Embedded Operating System
- Serial line device driver
- LCD device driver
- PIC pad device driver
- Scanner device driver
- Unique hardware identification code
- Multi-Language profiles

The following standard data and software packages are stored in flash ROM. Flash ROM is more expensive, but it is much more difficult to reverse engineer, and most importantly, it is electronically erasable. All of the more critical information is stored here. Flash ROM is used in an attempt to increase the difficulty of duplicating an BIA. (Flash ROM is well known in the industry).

- Unique DUKPT Future Key Table
- Unique 112-bit MAC Key
- DSP biometric quality determination algorithm
- DSP biometric encoding algorithm
- Random number generator algorithm
- Command function table

The message sequence number, incremented each time a message is sent from the BIA, is stored in the EEPROM. EEPROM can be erased many times, but is also nonvolatile — its contents remain valid across power interruptions. (EEPROM is well known in the industry).

The following data is stored in RAM. RAM is temporary in nature, and is lost whenever power is lost.

- Encoded Biometric Register
- PIC Register

- Account Index Code Register
- Title Index Code Register
- Amount Register
- Document Name Register
- 5   • PIC-Block Key
- Message Key
- Response Key
- Shared Session Key
- Private Session Key
- 10   • 8 General Registers
- stack and heap space

Each multichip module contains a "write-once" memory location that is irreversibly set following the initialization of the flash ROM. Whenever an attempt is made to download software to the flash ROM, this memory location is checked; if it is already been set, then the BIA refuses to load. This way, critical software and data keys may only be downloaded once into the device, at the time of manufacture.

All registers and keys are explicitly zeroed when a transaction is canceled. Once a transaction is completed, registers are cleared as well. Once a "form message" command is executed, biometric, PIC, and account index code registers are also cleared, along with any encryption keys that aren't required for subsequent use.

It is important that the software not keep copies of registers or keys in stack variables (known in the industry).

The following associated hardware components comprise the standard BIA hardware module.

- 30   • BIA Multichip module
- CCD single-print scanner
- capacitance detector plate (known in the industry)
- lighted PIC keypad
- 2-line 40-column LCD screen
- 35   • RF shielding
- tamper-resistant case

- serial connection (up to 57.6kb)
- breech detection hardware (known in the industry)
- optional thermite charge attached to Multichip module (known in the industry)

5

All temporary storage and internal hardware and software used to calculate these values are secured, which means they resist any attempts to determine their current values, or their means of functioning. This feature is essential for the security of the invention, just as it is critical that the "wiretapping" of an BIA and specifically the gathering of a Biometric-PIC Block for fraudulent means is made as difficult as possible.

10

The multichip module and the components are, where practical, physically connected to each other without exposed wiring being present.

15

The enclosure protecting the electronic components of the BIA is welded shut during manufacture; it cannot be opened under any circumstances without significant damage to the case. Upon detecting any opening (or damage) of the enclosure, the BIA performs an emergency electronic zero of any and all keys residing in flash ROM, followed by all of the software libraries. Specific breech detection methods are kept confidential and proprietary.

20

In addition to protecting the contents, the case also shields the internal operations from RF signal detectors.

Supersecure versions of the BIA exist whereby breech detection methods are connected to a mechanism that physically destroys the multichip module as well as the detection methods themselves.

25

#### 1.1.5. BIA Hardware: Wireless Model

The Wireless version of BIA hardware is identical to the Standard model in construction, except that it exports a spread-spectrum wireless communications module using an external antenna instead of an external serial port.

30

This version is designed to be used in restaurants, where transactions are authorized at the customer's convenience.

In the following descriptions, items which are added to the standard set are signified by the + character, while items that are removed from the standard set are signified by the - character.

**Multichip Module:**

- Document Name Register
- Shared Session Key
- Private Session Key
- Message Key

**Components:**

- Serial port
- + External antenna
- + Spread-spectrum wireless serial module (known in the industry)

**1.1.6. BIA Hardware: ATM Model**

The ATM version of BIA hardware is a multichip module combined with a heavy-duty single-print scanner and a serial port. The components are encased in a tamper-resistant case that makes attempts to penetrate obvious while also providing RF shielding for the contents.

This version is designed to be retrofitted into ATM locations. As such, the scanner pad is a heavy-duty sensor pad, and the entire construction makes use of the existing screens and keypads present in the ATM itself.

In the following descriptions, items which are added to the standard set are signified by the + character, while items that are removed from the standard set are signified by the - character.

**Multichip Module:**

- Amount Register
- Document Name Register
- Shared Session Key
- Private Session Key
- Message Key

**Components:**

- lighted PIC keypad
- 2-line 40-column LCD screen

5           Note that since the ATM has no LCD screen or PIC keypad, it really has no need of those device drivers in the mask ROM.

**1.1.7. BIA Hardware: Phone/CATV Model**

10           The Phone/CATV version of BIA hardware is a multichip module combined with a single-print scanner and a serial port. The module is physically attached to the scanner, and the whole is encased in plastic in order to make tampering more difficult. Some amount of RF shielding is provided for the components.

15           This version is designed to be integrated with telephones, television remote controls, and fax machines. As a result, it makes use of the existing keypads and LCD or television screens to enter or display values. It also uses the communication facilities of the host terminal. For example, the fax machine uses the built-in fax modem and the television remote uses the CATV cable network.

20           This hardware model is (in comparison with other models) relatively insecure, as it is intended that these devices cost as little as possible, be lightweight, and integrate easily with existing low-cost devices.

25           Of course, higher-security versions with more complete enclosures are possible and encouraged.

          In the following descriptions, items which are added to the standard set are signified by the + character, while items that are removed from the standard set are signified by the - character.

**Multichip Module:**

- Document Name Register
- Shared Session Key
- Private Session Key
- 35       - Message Key

**Components:**

- lighted PIC keypad
- 2-line 40-column LCD screen

**1.2. BIA Software****1.2.1. BIA Software Command Interface:**

The external interface to the BIA is much like a standard modem; commands are sent to it from a controlling terminal using the external serial line. When a command completes, a response code is sent from the BIA to the terminal.

Each BIA software load supports a different set of operations. For instance, a retail load supports only transaction authorizations, while a registration load supports individual identification and biometric registration.

All BIA data fields are in printable ASCII, with fields separated by field separator (or "fs") control character, and records separated by newlines. Encrypted fields are binary converted to 64-bit ASCII using the base-64 conversion library (all known in the industry).

Some commands are not available in some configurations. For instance, the ATM BIA cannot "Get PIC", since there is no attached PIC pad. Instead, the ATM BIA supports a "Set PIC" command.

**Response Codes:****Out of time:**

The time allotted for the command has expired. A message to that effect will be displayed on the LCD screen, if available. When time expires for a given command, the BIA acts as if the cancel button was pushed.

**Canceled:**

The "cancel" button has been pushed, and the entire operation has been canceled. This has the side effect of clearing all information



which was gathered. A message to that effect will be displayed on the LCD screen, if available.

**Ok:**

The command was successful.

**Other:**

Each command may have specific other response codes which are valid only for it. These response codes will generally have text accompanying the code, which will be displayed on the LCD screen if it is available.

**Message:**

This indicates that the command is ongoing, but that the BIA wants to send a message to the terminal with an interim result message. The result is also displayed on the LCD, if available. This facility is used for prompts, as well as status messages.

**Commands:**

In the argument list of the commands below, the <> characters surround individual arguments, [] characters surround optional arguments, and the | character indicates that a given argument may be comprised of one of the choices presented.

**Set Language <language-name>**

This command selects from one of a number of different languages encoded within the BIA for prompting for user input.

**Get Biometric <time> [primary|secondary]**

This command requests the BIA to activate its scanner to get biometric input from the individual, storing it into the Encoded Biometric Register.

First, the message "Please place finger on lighted panel" is displayed on the LCD panel and returned to the terminal. The scanner pad is illuminated, prompting the individual to enter his biometric.

A <time> value of zero means that there is no limit to the time for biometric scan input.

When in scanning mode, a fingerprint scan is taken and given a preliminary analysis by the print quality algorithm. If the scan is not good enough, the BIA continues to take new scans until <time> seconds pass. As time passes and snapshots of the print are taken and analyzed, messages are posted to the LCD screen and sent to the terminal based on the problems detected by the print quality software. If no print of appropriate quality is forthcoming, the BIA returns an error code of time expired, displaying a message to that effect on the LCD.

Once the print quality algorithm affirms the quality of the print scan, the print's minutiae are then extracted by the print encoding algorithm. Only a subset of the minutiae are selected at random, with care taken to retain enough sufficient for identification. These minutiae are then ordered randomly, and are placed in the Encoded Biometric Register. Then the BIA responds with the success result code.

If the [primary|secondary] is specified (only available in the biometric registration command set) then the entire minutiae set is selected, not just the smaller subset. Likewise, primary/secondary biometric selection ends up placing the encoded biometric into the appropriate register.

Whether or not the operation succeeds, as soon as scanning has terminated, the light indicating that scanning is in progress is turned off.

It is very important that the same biometric input yields different encodings, so as to complicate the task of anyone attempting to discover the encryption codes of a captured BIA. This is accomplished by the selection of a random subset and random ordering of the encoded biometric.

#### **Get PIC <time>**

This command requests the BIA to fill the PIC Register by reading from the keypad.

First, the message "Please enter your PIC, then press <enter>" is displayed on the LCD display and sent to the terminal, the appropriate keypad lights are turned on, and then keypad scanning begins.

Scanning terminates when either <time> number of seconds runs out, or when the individual hits the "enter" key.

Note that the individual digits of the PIC are not displayed on the LCD panel, but for each digit the individual types, a star "\*" appears to give the individual feedback. When the "correction" key is pressed, the last digit entered is erased, allowing the individual to fix input mistakes.

When PIC input terminates, the keypad lights turns off.

If successful, the command returns OK.

#### Get Account Index Code <time>

First, the message "Now enter your account index code, then press <enter>" is displayed on the LCD and sent to the terminal. This prompts the individual to enter his account index code. When each key is pressed, that value appears on the LCD panel. The correction button can be pressed to erase one of the values. When the "enter" button is pressed, the Account index code register is set.

During input, the appropriate keypad keys are lit, and when input is concluded, the keypad lights are turned off.

If successful, the command returns OK.

#### Get Title Index Code <time>

First, the message "Please enter your title index code, then press <enter>" is displayed on the LCD and sent to the terminal. This prompts the individual to enter his title index code. When each key is pressed, that value appears on the LCD panel. The correction button can be pressed to erase one of the values. When the "enter" button is pressed, the Title Index Code register is set.

During input, the appropriate keypad keys are lit, and when input is concluded, the keypad lights are turned off.

If successful, the command returns OK.

#### Validate Amount <amount> <time>

The Validate Amount command sends the message "Amount <amount> OK?" to the terminal, and displays it on the LCD screen. If the individual confirms the amount by hitting the "yes" (or enter) button, the Amount Register is set to <amount>. The <amount> value must be a valid number,

with no control characters or spaces, etc. During prompting, the yes, no, and cancel buttons are lit. Once prompting is complete, all the lights are turned off.

If the individual enters "no", then the transaction is canceled.

#### **Enter Amount <time>**

The Enter Amount command sends the message "Enter amount" to the terminal, and also displays it on the LCD screen as well. The individual must then enter the dollar amount himself. Each character entered is displayed on the LCD screen. All appropriate buttons are lit. If the enter button is hit, the Amount Register is set to be the value entered on the keyboard. Once entry is complete, all the lights are turned off.

#### **Validate Document <name> <time>**

The Validate Document command sends the message "Document <name> OK?" to the terminal, and displays it on the LCD screen as well. If the individual confirms the document by hitting the "yes" (or enter) button, the Document Name Register is set to <name>. The <name> must be printable ASCII, with no control characters, and no leading or trailing spaces. During prompting, the yes, no, and cancel buttons are lit. Once prompting is complete, all the lights are turned off.

If the individual enters "no", the transaction is canceled.

#### **Assign Register <register> <text>**

The assign register command sets the designated General <register> to have the value <text>. This is used to set information such as the merchant code, the product information, and so on.

#### **Get Message Key**

The Get Message Key command causes the BIA to generate a 56-bit random key to be used by the controlling hardware to encrypt any message body that the controlling device wishes to add to the message. That generated key is returned by the BIA in hexadecimal format (known in the industry). The message key are then added to the biometric-PIC block.

**Form Message <type=identification|transaction|account access...>**

The form message command instructs the BIA to output a message containing all the information it has gathered. It also checks to make sure that all the registers appropriate to that specific message <type> have been set. If all required registers are not set, the BIA returns with an error. The specific command set software will determine which messages can be formed by that BIA model; all others will be rejected.

Each message includes a transmission code consisting of the BIA's unique hardware identification code and an incrementing sequence number. The transmission code allows the DPC to identify the sending BIA and to detect resubmission attacks.

The BIA uses the DUKPT key management system to select the biometric-PIC block encryption 56-bit DES key from the Future Key Table. This key is then used to encrypt the Biometric-PIC Block using cipher block chaining (CBC). In addition, a response DES key is also generated randomly, and is used by the DPC to encrypt the portions of the response that need to be encrypted.

Note: splitting the response key from the biometric-PIC block key is very important, since each encryption key must be used only within the context of its own responsibilities. That way, if someone were to break the key encoding the private code, it would not result in the disclosure of the biometric-PIC.

The Biometric-PIC block consists of the following fields:

300-byte authorization biometric

4-12 digit PIC

56-bit response key

[optional 56-bit message key]

Note that the message key is only present if the controlling terminal has requested a message key for this message. It is up to the controlling terminal to encrypt any message body attached to the transaction authorization request using the message key.

Once all encryption is complete, the BIA outputs the body of the appropriate request message (such as a Transaction Authorization

Request message), terminated by and protected with the Message Authentication Code (MAC).

5 The MAC field is calculated using the BIA's secret 112-bit DES MAC key, and covers all message fields from first to last. The MAC assures the DPC that nothing in the message has changed effectively sealing the message, while still allowing the plaintext fields to be inspected by the controlling terminal.

10 When the Form Message command is done, the BIA sends the message "I'm talking to DPC Central" to the terminal as well as displaying it on the LCD screen, indicating that work is proceeding on the request.

The command returns OK in addition to returning the entire formed message upon completion of the command.

#### **Show Response <encrypted response> <time>**

15 The Show Response command instructs the BIA to use its current Response Key to decrypt the private code from the system.

After decryption, a chime sounds, and the private code is displayed on the LCD screen for <time> seconds. At no time does this command transmit the decrypted private code to the controlling terminal.

#### **Validate Private <encrypted validation> <time>**

20 This command is used by a terminal during a secure network communications session to ask the individual to validate a message from an outside source. The message comes encrypted and in two parts: the challenge, and the response.

25 Upon receipt of a Validate Private command, the BIA displays the text of the challenge message as in "OK <challenge>?" on the LCD screen, but does not send this to the terminal. When the individual validates the challenge, the response is encrypted by the BIA using the Private Session Key, and then returned to the terminal along with the OK response code. If the individual does not validate the challenge, then the BIA returns with a "failed" response code, along with the text "transaction canceled at your request," which is also displayed on the LCD screen.

30 Note that the terminal is never allowed to see the plaintext of either the challenge or the response.

**Reset**

The Reset command instructs the BIA to clear all temporary registers, the LCD screen, all temporary Key registers, and to turn off all keypad lights that may be on.

**Set PIC <value>**

This command assigns the BIA's PIC Register to be <value>.

Note that allowing a non-secured device to provide the PIC is a potential security problem, because non-secured devices are much more vulnerable to wiretapping or replacement.

**Set Account index code <value>**

This command assigns the BIA's Account index code Register to be <value>.

Note that allowing a non-secured device to provide the account index code is a potential security problem, because non-secured devices are much more vulnerable to wiretapping or replacement.

**Set Title Index Code <value>**

This command assigns the BIA's Title Index Code Register to be <value>.

Note that allowing a non-secured device to provide the Title Index Code is a potential security problem, because non-secured devices are much more vulnerable to wiretapping or replacement.

**Set Amount <value>**

This command assigns the BIA's Amount Register to be <value>.

**Decrypt Response <encrypted response message>**

The Decrypt Response command instructs the BIA to use it's current Response Key to decrypt the encrypted portion of the response message. Once decrypted, the response is returned to the controlling device, presumably for display on the ATM terminal's LED screen.

Note that providing this decryption ability is a security problem, as once the plaintext leaves the BIA, the terminal has the ability to do with it what it will.

### 1.2.2. BIA Software: Support Libraries

The BIA software is supported by several different software libraries. Some of them are standard, generally available libraries, but some have special requirements in the context of the BIA.

#### 1.2.2.1. Random Number Generator

Since the BIA is constantly selecting random DES keys for use in the message body and message response encryption, it is important that the keys selected be unpredictable keys. If the random number generator is based on time of day, or on some other externally-predictable mechanism, then the encryption keys will be much more easily guessed by an adversary that happens to know the algorithm. In order to assure the security of the encryption techniques used in the BIA, it is assumed that both the random number generator algorithm as well as the encryption algorithms are both publicly known.

A standard random number algorithm for generating DES keys is defined in ANSI X9.17, appendix C (known in the industry).

#### 1.2.2.2. DSP Biometric Encoding Algorithms

The biometric encoding algorithm is a proprietary algorithm for locating the minutiae that are formed by ridge endings and bifurcations on human fingertips. A complete list of minutiae is stored in the DPC as a reference, while only a partial list is required by the algorithm when performing a comparison between an identification candidate and a registered individual.

During both biometric registration as well as identification, the encoding algorithm ensures that enough minutiae are found before ending the biometric input step.



### 1.2.2.3. Operating System and Device Drivers

5 The BIA is a realtime computing environment, and as such requires a realtime embedded operating system to run it. The operating system is responsible for taking interrupts from devices and scheduling tasks.

10 Each device driver is responsible for the interface between the operating system and the specific hardware, such as the PIC pad device driver, or the CCD Scanner device driver. Hardware is the source for events such as "PIC pad key pressed", or "CCD Scanner scan complete". The device driver handles such interrupts, interprets the events, and then takes action on the events.

### 1.2.2.4. DES Encryption Library

15 There are any number of DES implementations publicly available. DES implementations provide a secret key-based encryption from plaintext to ciphertext, and decryption from ciphertext to plaintext, using 56-bit secret keys.

### 1.2.2.5. Public Key Encryption Library

20 Public Key encryption support libraries are available from Public Key Partners, holders of the RSA public key patent (known in the industry). Public Key cryptosystems are asymmetric encryption systems that allow communication to take place without requiring a costly exchange of secret keys. To use a public key encryption system, a public key is used to encrypt a DES key, and then the DES key is used to encrypt a message. The BIA uses public key cryptosystems to provide for the secure exchange of secret keys.

25 30 35 Unfortunately, public key systems are significantly less well tested than secret-key systems, and as such there is an overall lower level of confidence in such algorithms. As a result, the invention uses public key cryptography for communications security and short-lived credential exchange, and not long-term storage of secrets. Both the end-user individual and the bank are identified by the DPC to create the network

credential. The network credential includes the end-user individual's identification as well as the context of the connection (i.e., the TCP/IP source and destination ports).

#### 1.2.2.6. DUKPT Key Management Library

The derived unique key per transaction key (DUKPT) management library is used to create future DES keys given an initial key and a message sequence number. Future keys are stored in a Future Key Table. Once used, a given key is cleared from the table. Initial keys are only used to generate the initial future key table. Therefore the initial key is not stored by the BIA

The use of DUKPT is designed to create a key management mechanism that provided a different DES key for each transaction, without leaving behind the trace of the initial key. The implications of this are that even successful capture and dissection of a given future key table does not reveal messages that were previously sent, a very important goal when the effective lifetime of the information transmitted is decades. DUKPT is fully specified in ANSI X9.24 (known in the industry).

DUKPT was originally developed to support PIC encryption mechanisms for debit card transactions. In this environment, it was critical to protect all transactions. An assumption is made that a criminal records encrypted transactions for a six month period, and then captures and successfully extracts the encryption code from the PIC pad. The criminal could then manufacture one new counterfeit debit card for each message that had been transmitted over that six month period. Under DUKPT, however, the criminal's theft and dissection would not allow him to decrypt previous messages (although new messages would still be decryptable if the criminal were to replace the PIC pad subsequent to dissection).

In the biometric-PIC situation, the criminal has an even harder time, as even if messages are decrypted, turning a digital biometric-PIC into a physical fingerprint is much harder than turning an account number-PIC into a plastic card, which is one of the significant benefits of the tokenless system.

Still, if a criminal can decrypt, he can encrypt, which might allow him to electronically submit a biometric-PIC to the system to

authorize a fraudulent transaction. While this is quite difficult, it is still best to restrict the options available to the criminal as much as possible, hence the use of DUKPT.

### 1.3. BIA Software Command Sets

#### 1.3.1. BIA Software: Retail Command Set

The BIA/Retail software interface exports an interface that allows specific retail point of sale terminals to interact with the system.

The BIA/Retail interface is designed to allow the terminal to perform the following operation:

##### Transaction Authorization

In order to implement those operations, the BIA/Retail provides the following command set:

Set Language <language-name>  
Get Biometric <time>  
Get PIC <time>  
Assign Register <register> <value>  
Get Account index code <time>  
Validate Amount <amount> <time>  
Enter Amount <time>  
Form Message <type>  
Show Response <encrypted response> <time>  
Reset

#### 1.3.2. BIA Software: CATV (Integrated Remote) Command Set

The BIA/CATV software interface exports a command set that allows terminals integrated with a Phone/CATV BIAs to interact with the system. The following operation is supported:

##### Remote Transaction Authorization

In order to implement that operation, the BIA/CATV provides the following command set:

5           Get Biometric <time>  
            Set PIC <text>  
            Assign Register <register> <text>  
            Set Account index code <text>  
            Form Message <type>  
10           Decrypt Response <encrypted response message>  
            Reset

### 1.3.3. BIA Software: Integrated FAX Command Set

15           The BIA/Fax software interface exports a command set that allows terminals integrated with a fax BIA to interact with the system. The following operations are supported:

20           Secure Fax Submit  
            Secure Fax Data  
            Secure Fax Tracking  
            Secure Fax Retrieve  
            Secure Fax Reject  
            Secure Fax Archive  
25           Secure Fax Contract Accept  
            Secure Fax Contract Reject  
            Electronic Document Archive Retrieve

30           In order to implement these operations, the BIA/Fax provides the following command set:

            Get Biometric <time>  
            Set PIC <text>  
            Set Title Index Code <text>  
35           Assign Register <register> <value>  
            Get Message Key

Form Message <type>  
Decrypt Response <encrypted response message>  
Reset

#### 1.3.4. BIA Software: Registration Command Set

The BIA/Reg software interface exports an interface that allows general purpose computers to interact with the system to identify and register individuals. The following operations are supported:

Individual Identification  
Biometric Registration

In order to support those operations, the BIA/Reg provides the following command set:

Set Language <language-name>  
Get Biometric <time> [primary/secondary]  
Get PIC <time>  
Assign Register <register> <text>  
Get Message Key  
Form Message <type>  
Show Response <encrypted response> <time>  
Reset

#### 1.3.5. BIA Software: PC Command Set

The BIA/PC software interface exports a command set that allows general purpose computers to send, receive, and sign electronic documents, conduct transactions across the network, and provide biometric-derived credentials to sites on the network. The following operations are supported:

Electronic Document Submit  
Electronic Document Data  
Electronic Document Tracking

5 Electronic Document Retrieve  
Electronic Document Reject  
Electronic Document Archive  
Electronic Document Archive Retrieve  
Electronic Signature Submission  
Electronic Signature Check  
Remote Transaction Authorization  
Network Credential  
10 Secured Connection

In order to support those operations, the BIA/PC provides the following command set:

15 Set Language <language-name>  
Get Biometric <time>  
Get PIC <time>  
Get Account index code <time>  
Validate Amount <amount> <time>  
Enter Amount <time>  
20 Validate Document <name> <time>  
Assign Register <register> <text>  
Get Message Key  
Form Message <type>  
Show Response <encrypted response> <time>  
25 Validate Private <encrypted validation> <time>  
Reset

### 1.3.6. BIA Software: Issuer Command Set

30 The BIA/Iss software interface exports an interface that allows general purpose computers to interact with the system to authenticate and submit batch change requests. The following operation is supported:

35 Issuer Batch

In order to implement this operation, the BIA/Iss provides the following command set:

Set Language <language-name>  
Get Biometric <time> [primary|secondary]  
Get PIC <time>  
Assign Register <register> <value>  
Get Message Key  
Form Message <type>  
Show Response <encrypted response> <time>  
Reset

### 1.3.7. BIA Software: Internal Command Set

The BIA/Int exports a command set that allows general purpose computers to interact with the system to identify individuals. The following operation is supported:

#### Individual Identification

In order to implement this operation, the BIA/Int provides the following command set:

Set Language <language-name>  
Get Biometric <time>  
Get PIC <time>  
Assign Register <register> <value>  
Get Message Key  
Form Message <type>  
Show Response <encrypted response> <time>  
Reset

### 1.3.8. BIA Software: ATM Command Set

The BIA/ATM software interface exports a command set that allows ATMs to identify individuals. The following operation is supported:

### Account Access

In order to implement this operation, the BIA/ATM provides the following command set:

Get Biometric <time>  
Set PIC <text>  
Set Account index code <text>  
Assign Register <register> <value>  
Form Message <type>  
Decrypt Response <encrypted response message>  
Reset

## 1.4. Terminals

### 1.4.1. Introduction

The terminal is the device that controls the BIA and connects to the DPC via modem, X.25 connection, or Internet connection — methods well-known to the industry. Terminals come in different shapes and sizes, and require different versions of the BIA to perform their tasks. Any electronic device, which issues commands to and receives results from the biometric input device, can be a terminal.

Some terminals are application programs that run on a general purpose microcomputer, while other terminals are combinations of special purpose hardware and software.

While the terminal is critical for the functioning of the system as a whole, the system itself places no trust in the terminal whatsoever. Whenever a terminal provides information to the system, the system always validates it in some manner, either through presentation to the individual for confirmation, or by cross-checking through other previously registered information.

While terminals are able to read some parts of BIA messages in order to validate that the data was processed properly by the BIA,



terminals cannot read biometric identification information including the biometric, the PIC, encryption keys, or account index codes.

Specific BIAs export some security functionality to the terminal, such as PIC entry, and private code display. As a result, such devices are regarded as somewhat less secure than their entirely self-contained counterparts, and as such have consequently lower security ratings.

There are many different terminal types; each is connected to a specific model BIA. Each terminal is described in brief below:

**ATM (Automated Teller Machinery)**

Integrated BIA/ATM with ATM software load provides biometric-PIC access to ATM cash dispensers.

**BRT (Biometric Registration Terminal)**

Standard BIA with Registration software load attached to a microcomputer provides banks with the ability to register new individuals with the system along with their financial asset accounts and other personal information.

**CET (Certified Email Terminal)**

Standard BIA with PC software load attached to a microcomputer provides individuals with the ability send, receive, archive, reject, and track certified email messages.

**CPT (Cable-TV Point of Sale Terminal)**

BIA/catv with CATV software load attached to the CATV broadband provides individuals with biometric-television (or "TV") remotes with the ability to authorize television shopping purchases.

**CST (Customer Service Terminal)**

Standard BIA with Internal software load attached to a microcomputer system authorizes employees to construct database requests for the purposes of customer service.

**EST (Electronic Signature Terminal)**

Standard BIA with personal computer software load attached to a microcomputer provides individuals with the ability to construct and verify electronic signatures on documents.

5

**IPT (Internet Point of Sale Terminal)**

Standard BIA with personal computer software load attached to a microcomputer provides individuals with internet connections the ability to purchase products from a merchant that is connected to the Internet.

10

**IT (Issuer Terminal)**

Standard BIA with Issuer software load attached to a microcomputer provides banks with the ability to send batched changes of asset accounts to the DPC.

15

**ITT (Internet Teller Terminal)**

Standard BIA with personal computer software load attached to a microcomputer with an internet connection provides individuals with the ability to perform transactions with their favorite Internet Bank.

20

**PPT (Phone Point of Sale Terminal)**

BIA/catv with CATV software load integrated with a telephone provides individuals with the ability to authorize transactions over the telephone.

25

**RPT (Retail Point of Sale Terminal)**

Standard BIA with Retail software load attached to an X.25 network or using a modem allows an individual to purchase items using transaction authorizations in a store.

30

**SFT (Secure Fax Terminal)**

BIA/catv with Fax software load integrated with a fax machine provides individuals with the ability to send, receive, reject archive, and track secured fax messages.

35

## 1.4.2. Terminal: Retail Point of Sale Terminal

### 1.4.2.1. Purpose

5           The purpose of the RPT is to allow individuals to purchase items at a store without having to use either cash, check, or a debit or credit card.

10           The RPT uses a BIA/Retail to authorize financial transactions from an individual to a merchant. In addition to being used to accept biometric-PIC authorizations, the RPT provides standard debit and credit card scanning functions as well.

15           Note that only the biometric-related transactions are described in detail here. It is assumed that the RPT will also consist of standard credit and debit magnetic stripe card readers, as well as optional smart card readers too.

### 1.4.2.2. Construction

20           Each RPT is connected to the DPC by a modem, an X.25 network connection, an ISDN connection, or similar mechanism. The RPT may also be connected to other devices, such as an electronic cash register, from which it obtains the amount of the transaction and the merchant code.

25           The RPT consists of:

- an BIA/Retail
- an inexpensive microprocessor
- 9.6 kb modem/X.25 network interface hardware
- merchant identification code number in non-volatile RAM
- a DTC serial port for connecting to the BIA
- 30   • magnetic stripe card reader (known in the industry)
- ECR (electronic cash register) connection port
- optional smart card reader (known in the industry)

#### 1.4.2.3. Identification

Two entities need to be identified for the DPC to respond positively to an BIA transaction authorization request: the individual, and the merchant.

The individual is identified by the biometric-PIC, and the merchant is identified by the DPC, which cross-checks the merchant code contained in the BIA's VAD record with the merchant code added to the transaction request by the RPT.

#### 1.4.2.4. Operation

First, the merchant enters the value of the transaction into his electronic cash register. Then, the individual enters his biometric-PIC, his account index code, and then validates the amount. The RPT then adds the product information and the merchant code to the BIA, instructs the BIA to construct the transaction, and then sends the transaction to the DPC through its network connection (modem, X.25, etc).

When the DPC receives this message, it validates the biometric-PIC, obtains the account number using the index code, and cross-checks the merchant code in the message with the registered owner of the BIA. If everything checks out, the DPC forms and sends a credit/debit transaction to execute the exchange. The response from the credit/debit network is added to the private code to form the transaction response message, which the DPC then sends back to the RPT. The RPT examines the response to see whether or not the authorization succeeded, and then forwards the response to the BIA, which then displays the individual's private code, concluding the transaction.

#### 1.4.2.5. Security

Messages between the RPT and the DPC are secured by encryption and MAC calculation from the BIA. The MAC allows the RPT to review the unencrypted parts of the message, but the RPT cannot change them. Encryption prevents the encrypted part of the message from being disclosed to the RPT.

Each retail BIA must be registered to a merchant. This helps to discourage BIA theft. Furthermore, because the RPT adds the merchant code onto each message, replacing a merchant's BIA with a different BIA is detected by the cross-check performed at the DPC.

#### **1.4.3. Terminal: Internet Point of Sale Terminal**

##### **1.4.3.1. Purpose**

The purpose of an Internet Point of sale Terminal (IPT) is to authorize credit and debit financial transactions from an individual at a computer to a merchant, both of whom are on the Internet.

Note that the Internet simply represents a general purpose network where a merchant, the DPC, and the IPT can all connect to each other in real time. As a result, this mechanism would work exactly the same on any other general purpose network.

##### **1.4.3.2. Construction**

The IPT consists of:

- an BIA/PC
- a microcomputer
- an Internet Shopper software application
- an Internet (or other network) connection

##### **1.4.3.3. Identification**

In addition to identifying the individual, the IPT must also identify the remote merchant who is the counterparty to the transaction. The merchant must also identify both the DPC and the IPT.

The Internet Shopper program stores the hostname (or other form of net name) of the merchant from which the purchase is taking place in order to verify the merchant's identity. Since the merchant registers all of his legitimate internet hosts with the DPC, this allows the DPC to cross-check the merchant code with the merchant code stored under that hostname to verify the merchant's identity.

#### 1.4.3.4. Operation

First, the IPT connects to the merchant using the Internet.

5 Once a connection is established, the IPT secures it by generating and then sending a Session Key to the merchant. In order to assure that the session key is protected from disclosure, it is encrypted with the merchant's Public Key using Public Key Encryption. When the merchant receives this encrypted Session Key, he decrypts it using his Private Key. This process  
10 is called securing a connection through a Public Key Encrypted secret key exchange.

Once connected, the IPT downloads the merchant code, and both price and product information from the merchant. Once the individual is ready to make a purchase, he selects the merchandise he wishes to buy.  
15 Then, the individual enters the biometric-PIC using the BIA/PC, the IPT sends the merchant code, the product identification information, and the amount to the BIA, and instructs it to construct a Remote Transaction Authorization request. Then the IPT sends the request to the merchant via the secure channel.

20 The merchant is connected to the DPC via the same sort of secure connection that the IPT has with the merchant, namely, using Public Key Encryption to send a secure session key. Unlike the IPT- merchant connection, however, merchant-DPC session keys are good for an entire day, not for just one connection.

25 The merchant connects to the DPC, securing the connection using the session key, forwarding the transaction to the DPC for validation. The DPC validates the biometric-PIC, cross-checks the merchant code contained in the request with the merchant code stored under the hostname that was sent in the request, and then sends a transaction to the credit/debit  
30 network. Once the credit/debit network responds, the DPC constructs a reply message including the credit/debit authorization, an encrypted private code, and the address of the individual, and sends that message back to the merchant.

35 Once the merchant receives the reply, it copies the individual's mailing address out of the reply, makes note of the authorization code, and forwards the reply message to the IPT.

The IPT hands the reply to the BIA, which decrypts the private code and displays it on the LCD screen, indicating that the DPC recognized the individual. The IPT also shows the result of the transaction as well, be it success or failure.

#### 1.4.3.5. Security

Since the system in general assumes that an adversary inhabiting the network can hijack network connections at any point, all parties must have secure communications during their realtime interactions. The main concern isn't disclosure of information, but rather insertion or redirection of messages.

The whole system of Public Key Encryption relies on having a trusted source for the Public Keys. These trusted sources are called Certifying Authorities, and we assume that such a source will be available on the Internet in the near future.

#### 1.4.4. Terminal: Internet Teller Terminal

##### 1.4.4.1. Purpose

The Internet Teller Terminal (ITT) is used to identify individuals for internet banking sessions. The DPC, the bank's computer system, and the individual are all connected to the Internet.

There are two main tasks. The first is providing a secure communications channel from the ITT to an internet bank. The second is providing unimpeachable identity credentials to the internet bank. Once both are accomplished, the ITT can provide a secure internet banking session. In addition, the BIA's challenge-response verification capability is used to provide additional security for all high-value and/or irregular transactions.

#### 1.4.4.2. Construction

The ITT consists of:

- an BIA (standard PC model)
- a microcomputer
- an Internet Teller software application
- an Internet connection

The ITT accepts biometric identification using an BIA/PC connected to the microcomputer serving as the individual's Internet terminal.

#### 1.4.4.3. Identification

Both the individual and the bank are identified by the DPC to create the network credential. The network credential includes the individual's identification as well as the context of the connection (i.e., the TCP/IP source and destination ports).

The DPC identifies the bank by cross-checking the code that the bank sends to the ITT with the bank's hostname that the ITT sends to the DPC.

#### 1.4.4.4. Operation

First, the ITT connects to the internet bank, making sure that the bank has the computing resources required to handle a new session for the individual. If the bank has sufficient resources, it sends back the bank identification code to the ITT.

Once connected, the ITT instructs the BIA to obtain the biometric-PIC and the account index code from the individual. Then the ITT adds both the bank's hostname as well as the bank code. Using all this information, the BIA is then asked to form a network credential request message which the ITT sends to the DPC via the Internet.

When the DPC receives this message, it validates the biometric-PIC, obtains the account number using the index code, and makes sure that the bank code from the message matches the bank code stored under the



bank's hostname in the Remote Merchant database. The DPC also checks to make sure that the account number returned by the index code belongs to the bank as well. If all checks out, then the DPC creates a network credential using the individual's account identification, the time of day, and the bank code. The DPC signs this credential using Public Key Encryption and the DPC's Private Key. The DPC retrieves the bank's public key, and the individual's private code, and with the credential forms the network credential response message. The response message is encrypted using the BIA response key, and is then sent back to the ITT.

When the ITT receives the response, it hands the response message to the BIA. The BIA decrypts and then displays the individual's private code on the LCD screen. The bank's public key is stored in the Public Key register. Two random session keys are generated by the BIA. The first key, called the Shared Session Key, is revealed in plaintext to the ITT. The ITT uses this shared session key to secure the connection with the bank.

The other session key, called the Private Session Key, is not shared with the ITT. It is used for the BIA's challenge-response mechanism, a mechanism that allows the bank to obtain specific validation for non-routine transactions straight from the individual, without involving the (untrustworthy) ITT.

After receiving the Shared Session Key, the ITT asks the BIA to form a Secure Connection Request message, which includes both session keys and the network credential, and are all encrypted with the bank's public key. The ITT then sends the Secure Connection Request message to the bank.

When the bank receives the request message, it decrypts the message using its own Private Key. Then, it decrypts the actual network credential using the DPC's public key. If the network credential is valid and has not expired (a credential times out after a certain number of minutes), the individual is authorized, and the conversation continues, with the session key used to ensure security.

Whenever the individual performs any non-routine or high-value transactions, the bank may wish to ask the individual to validate those transactions for extra security. To do so, the bank sends a challenge-response message encrypted with the Private Session Key to the

ITT, which forwards that challenge-response message to the BIA. The BIA decrypts the message, displays the challenge (usually of the form "Transfer of \$2031.23 to Rick Adams OK?"), and when the individual validates by hitting the OK button, the BIA re-encrypts the response with the Private Session Key and sends that message to the ITT, which forwards it to the bank, validating the transaction.

#### 1.4.4.5. Security

The system makes use of public key cryptography to both provide credentials and to secure communications between the ITT and the bank.

For this mechanism to function properly, the bank must know the DPC's public key, and the DPC must know the bank's public key. It is critical to the security of the system that both parties keep the respective public keys secure from unauthorized modification. Note that public keys are readable by anyone, they just cannot be modifiable by anyone. Of course, any session or secret keys must be kept secure from observation, and those secret keys must be destroyed after the session has ended.

The extra validation step for non-routine transactions is necessary because of the relative difficulty involved in securing personal computer applications on the Internet due to viruses, hackers, and individual ignorance. Banks should probably restrict routine money transfers available to ITT's to include only money transfers to well-known institutions, such as utility companies, major credit card vendors, and so on.

#### 1.4.5. Terminal: Electronic Signature

##### 1.4.5.1. Purpose

The electronic signature terminal (EST) is used by individuals to generate electronic signatures that cannot be forged for electronic documents. The EST either allows individuals to sign electronic documents, or verifies electronic signatures already on such documents.

#### 1.4.5.2. Construction

The EST consists of:

- an BIA/PC
- a microcomputer
- a message digest encoder algorithm
- a modem, an X.25 connection, or an Internet connection
- an electronic signature software application

The EST uses an BIA/PC attached to a microcomputer, with events controlled by an electronic signature software application.

#### 1.4.5.3. Identification

To create a digital signature without using some sort of public/private keyed token, three things need to be done. First, the document to be signed needs to be uniquely identified, the time of day needs to be recorded, and the individual performing the signature needs to be identified. This links the document, the individual, and the time, creating a unique time stamped electronic signature.

#### 1.4.5.4. Operation

First the document to be signed is processed by a message digest encoding algorithm that generates a message digest code. One such algorithm is the MD5 algorithm by RSA, which is well known in the industry. By their nature, message digest algorithms are specifically designed so that it is almost impossible to come up with another document that generates the same message digest code.

Then, the individual enters his biometric-PIC using the BIA, the message digest code is handed to the BIA, the name of the document is added, and the resulting Digital Signature request message is sent to the DPC for authorization and storage.

When the DPC receives the request, it performs a biometric identity check, and once the individual is verified, it collects the message digest encoding, the individual's biometric account number, the current

time of day, the name of the document, and the identification of the BIA that gathered the signature, and stores them all in the Electronic Signatures Database (ESD). The DPC then constructs a signature code text string that consists of the ESD record number, the date, the time, and the name of the signer, and sends this signature code along with the individual's private code back to the EST.

To check an electronic signature, the document is sent through the MD5 algorithm (known in the industry), and the resulting value together with the electronic signature codes are given to the BIA along with the requesting individual's biometric-PIC, and the message is sent to the DPC. The DPC checks each signature for validity, and responds as appropriate.

#### 1.4.5.5. Security

The BIA doesn't encrypt any of the data relating to electronic signatures, so document titles along with specific MD5 values are sent in plaintext. The same situation holds true for signature validations.

Thus while signatures cannot be forged, some of the details (including document names) are vulnerable to interception.

#### 1.4.6. Terminal: Certified Email Terminal

##### 1.4.6.1. Purpose

The purpose of the Certified Email Terminal (CET) is to provide individuals a way of delivering electronic messages to other individuals in the system while providing for identification of sender, verification of both receipt and recipient, and assuring confidentiality of message delivery.

The CET uses a BIA/PC to identify both the sender and the recipient. Security is established by encrypting the message, and then by encrypting the message key using the sender's BIA during the upload, and then decrypting the message key using the recipient's BIA during the download.

#### 1.4.6.2. Construction

Both the transmitter and the recipient CET consists of:

- a BIA
- a microcomputer
- a modem, an X.25 connection, or an Internet connection
- the ability to receive email
- a certified electronic mail application

A CET is actually a microcomputer with an electronic mail application and a network connection which invokes the BIA to generate biometric-PIC authorizations to send and receive certified electronic mail.

#### 1.4.6.3. Identification

In order to guarantee delivery of the message, both sender and recipients must be identified.

The sender identifies himself using his biometric-PIC when he uploads the message to the DPC. Each recipient the sender wishes to send the document to is identified either by biometric account identification number, or by fax number, and extension. In order for a recipient to download the message, he identifies himself using his biometric-PIC. This procedure resembles a person-to-person telephone call.

#### 1.4.6.4. Operation

Message delivery starts with an individual uploading a document or message, and identifying himself using his biometric-PIC. The individual then verifies the name of the document, and the email message is encrypted and uploaded.

Once a message is uploaded, the sender receives a message identification code that can be used to request the current delivery status of the document to each of the recipients.

The DPC sends an electronic mail message to each recipient, notifying them when a certified message has arrived.

Once the recipient receives the notification, the recipient may at his leisure either choose to accept or refuse that message or a group of messages by submitting his biometric-PIC and having it validated by the DPC.

Once successfully transmitted to all recipients, a document is removed after a predetermined period, generally 24 hours. Individuals wishing to archive the document, along with an indication of all of the individuals to whom the message was sent may submit message archival requests prior to the deletion of the message.

#### 1.4.6.5. Security

In order to effect the secure aspect of the transmission, the document is protected from disclosure en route. The CET accomplishes this using the 56-bit Message Key generated by the BIA. Since the BIA takes responsibility for encrypting the Message Key as part of the biometric-PIC, the encryption key is securely sent to the DPC.

When an individual downloads the message, the message key is sent encrypted along with the private code, to allow the recipient to decrypt the message. Note that it is fine to have all recipients have this message key, as they all receive the same message.

As with the ITT, individuals must take care to secure their CET application software from surreptitious modification, as a modified CET can send any document it wishes to once the individual validates the document name.

#### 1.4.7. Terminal: Secure Fax Terminal

##### 1.4.7.1. Purpose

The purpose of the secure fax terminal (SFT) is to provide individuals a way of delivering fax messages to other individuals in the system while providing for identification of sender, verification of both receipt and recipient, and assuring confidentiality of message delivery.

Each SFT uses an integrated BIA/catv to identify both the sender and the recipient. Communications security is accomplished through encryption.

#### 1.4.7.2. Construction

Both the transmitter and the recipient SFT consists of:

- an BIA/catv
- a fax machine
- optional ISDN modem

A SFT is a fax machine connected to the DPC via a modem. The system treats faxes as just another type of certified electronic mail.

#### 1.4.7.3. Identification

There are several different levels of security for secure faxes, but in the most secure version, the identity of the sender and all recipients is verified.

The sender identifies himself using his biometric-PIC and title index code when he sends his message to the DPC. To pick up the fax, each recipient listed identifies himself, again using biometric-PIC and title index code.

In addition, the receiving site is identified by phone number. This phone number is registered with the DPC. For secured- confidential faxes, each recipient is identified with the phone number and the extension.

#### 1.4.7.4. Operation

There are five basic types of faxes that an SFT can send.

##### I. Unsecured Faxes

Unsecured faxes are equivalent to a standard fax. The sender enters the phone number of the recipient site, and sends the fax. In this case, the sender remains unidentified, and the fax is sent to a given phone

number in the hopes that it will be delivered to the proper recipient. An SFT marks the top line on all such unsecured faxes prominently as being "UNSECURED". All faxes received from non-SFT fax machines are always marked as being unsecured.

## II. Sender-Secured Faxes

In a sender-secured fax, the sender selects the "sender-secured" mode on the fax machine, enters their biometric-PIC followed by their title index code. The fax machine then connects to the DPC, and sends the biometric-PIC information. Once the DPC verifies the individual's identity, the individual then sends the fax by feeding the document into the fax scanner. In this case, the fax is actually sent to the DPC, which stores the fax digitally. Once the entire fax arrives at the DPC, the DPC commences sending the fax to each destination, labeling each page with the name, title, and company of the sender, along with the banner of "SENDER-SECURED" at the top of each page.

## III. Secured Fax

In a secured fax, the sender selects the "secured" mode on the fax machine, enters their biometric-PIC followed by their title index code, and then enters the phone numbers of the recipients. Once the system verifies the sender's identity and each of the recipients phone numbers, the individual then sends the fax by feeding the document into the fax scanner. The fax is then sent to the DPC, which stores the fax digitally. Once the entire fax arrives at the DPC, the DPC sends a small cover page to the destination indicating the pending secured fax, the sender's title and identity, as well as the number of pages waiting, along with a tracking code. This tracking code is automatically entered into the memory of the recipient's fax machine.

To retrieve the fax, any employee of the recipient company can select the "retrieve fax" button on his fax machine, select which pending fax to retrieve by using the tracking code, and then enter biometric-PIC. If the fax is unwanted, the individual may press the "reject fax" button, though he must still identify himself to the system in order to



do this. Once validated as a member of the company, the fax is then downloaded to the recipient's fax machine. Each page has "SECURED" on the top of each page, along with the sender's identity and title information.

#### IV. Secured Confidential Fax

In a secured-confidential fax, the sender selects the "secured-confidential" mode on the fax machine, enters his biometric-PIC followed by his title and index code, and then enters the phone number and system extension of each recipient. Once the DPC verifies the sender's identity and each of the recipients phone numbers and extensions, the individual then sends the fax by feeding the document into the fax scanner. The fax is sent to the DPC, which stores the fax digitally. Once the entire fax arrives at the DPC, the DPC sends a small cover page to each destination indicating the pending secured-confidential fax, the sender's title and identity, the recipient's title and identity, as well as the number of pages waiting, along with a tracking code. This tracking code is automatically entered into the memory of the recipient's fax. However, the only individual that can retrieve the fax is the individual whose extension code is indicated.

This individual selects the "retrieve fax" button, selects the pending fax to retrieve, and then enters his biometric-PIC. Once validated as the recipient, the fax is then downloaded to the recipient's fax machine. Each page has "SECURED-CONFIDENTIAL" on the top of each page, along with the sender's title and identity information.

#### V. Secured Confidential Contract Fax

This fax is processed identically to the secured-confidential fax in terms of the actual delivery of the fax to the recipients, except that the fax is titled "contract" instead of secured-confidential. In addition, the DPC automatically archives contract faxes. Any recipient may accept or reject the contract through the SFT subsequent to receiving the contract fax. Hence with the option, the DPC performs the role of an electronic notary.

Any fax that is sent to the system and then forwarded to the recipient may be sent to any number of recipients without tying up the sending fax machine. Additionally, the tracking number of any fax sent is entered into the memory of the fax machine; a status report on any ongoing  
5 fax can be generated at the sending machine by selecting the "status" button and then selecting the particular fax pending tracking code. The DPC issues a report that is immediately sent to the sending fax machine detailing the state of the sending for each recipient.

With any secured or secured-confidential fax, an option exists for either the sender or one of the recipients to archive the fax (along with the specifics as to who sent and received the fax) for future reference. To  
10 this end, any secured fax is retained for some time period (i.e., 24 hours) following successful delivery. An archival tracking code is returned to the individual whenever an archive is requested. This archival code is used to  
15 retrieve faxes and fax status reports archived with the system.

Archived faxes are placed on read-only secondary storage after some time period (i.e., 24 hours). Retrieving an archived fax requires human intervention, and may take up to 24 hours to perform.

#### 20 1.4.7.5. Security

The SFT system works hard to assure the recipient of the sender's identity, and it works just as hard to assure the sender that the  
25 recipient actually acknowledged receipt of the document.

In order to protect against interception of the communications between the sender and recipient, the fax terminal encrypts the fax using the Message Key facility provided by the BIA. Since the BIA takes  
30 responsibility for encrypting the Message Key as part of the biometric-PIC, the encryption key is securely sent to the DPC.

When an individual receives a secured fax of any type, the message key is sent encrypted along with the private code, to allow the recipient to decrypt the message. Note that it is fine to have all recipients  
have this message key, as they all receive the same message.

#### 1.4.7.6. Notes

Sending secured faxes is very similar to sending electronic mail, and reuses much of the same software.

It is possible to construct fax terminals that do not have integral BIA/fax devices but that have a port suitable for attaching an external BIA/pc and software appropriate for using the BIA.

#### 1.4.8. Terminal: Biometric Registration Terminal

##### 1.4.8.1. Purpose

The purpose of the Biometric Registration Terminal (BRT) is to register new individuals including their biometric-PIC, mailing address, private code, electronic mail addresses, a list of titles and title index codes used to send and receive electronic messages and faxes, and a list of financial asset accounts and account index codes that they can access, all using their biometric-PIC.

The objective of the enrollment process is to obtain personal information from an individual at the location of a responsible institution where that information can be validated. This includes, but is not limited to retail banking outlets, and corporate personnel departments. Each participating responsible institution has one BRT that is used by a group of employees who have been authorized to perform registrations. Each employee is accountable for each individual registered.

##### 1.4.8.2. Construction

- an microcomputer and screen, keyboard, mouse
- an BIA/Reg
- 9.6 kb modem/X.25 network connection (known in the industry)
- a biometric registration software application

The BRT uses an attached BIA/Reg for biometric entry, and is connected to the system by a 9.6kb modem or an X.25 network connection

(known in the industry). Biometric registration terminals are located in places that are physically secure such as retail banking outlets.

#### 1.4.8.3. Identification

5

Three entities need to be identified for the DPC to respond positively to an BIA/Reg registration request: the registering employee, the institution, and the BIA/Reg. The employee must have been authorized to register individuals for that institution.

10

The institution and the BIA are identified by cross-checking the owner of the BIA with the institution code set by the BRT. The employee identifies himself to the system by entering his biometric- PIC upon starting the registration application.

15

The institution uses its standard customer identification procedure (signature cards, employee records, personal information, etc) before registering the individual on the system. It is important for the institution to verify individual identity as assiduously as possible, since the registering individual will be empowered to transfer money from those accounts at will, and/or send electronic messages using the name of the company.

20

#### 1.4.8.4. Operation

25

During registration, the individual enters both a primary and secondary biometric. The individual must use both index fingers; if the individual is missing index fingers, the next inner-most finger may be used. Requiring specific fingers to be used allows the prior fraud check to work.

30

The individual is encouraged to select a primary and a secondary finger; the primary finger is given preference during the DPC identity check, so the individual should present the most-often used finger as the primary. Of course, the DPC could choose to alter the designation of primary and secondary biometrics based on operations if it turns out to be important to do so.

35

As a part of the biometric encoding process, the BIA/R determines if the individual has entered "a good print." Note that there are some individuals whose jobs result in the accidental removal of their

fingerprints, such as individuals who work with abrasives or acids. Unfortunately, these individuals cannot use the system. They are detected at this stage in the process and informed that they cannot participate.

5 The individual selects a PIC of from four to twelve digits from a series of PIC options provided by the system's central database. However, the PIC must be validated by the system. This involves two checks: one, that the number of other individuals using the same PIC aren't too great (since the PIC is used to reduce the number of individuals checked by the biometric comparison algorithm), and that the individual being registered isn't too "close", biometrically speaking, with other individuals within the same PIC group. If either happens, the enrollment is rejected, an error message is returned to the BRT, and the individual is instructed to request a different PIC. The system may optionally return with an "identical match" error condition, which indicates that the individual already has a record in the system under that PIC.

10 A PIC of 0 allows the system to assign a PIC to the individual.

The individual constructs a confidential private code consisting of a word or phrase. If the individual does not wish to construct one, a private code will be constructed randomly by the terminal.

20 The individual may also arrange their financial asset code list. This list describes which account index code points at which account (i.e. 1 for debit, 2 for credit, 3 for emergency debit, etc). Note that this can only occur if the registering institution is a bank, and only if the accounts are owned by that particular banking institution.

25 Even after registration, an individual is not actually able to perform operations using the system until a prior fraud check is completed. This generally takes a few minutes, but during times of high load, it takes up to several hours. Only if the system finds no instance of prior fraud is the individual's account activated.

#### 30 1.4.8.5. Security

35 If an individual is found to have defrauded the system even once, the DPC institutes a database-wide involuntary biometric database search for the criminal. Several of these are performed each night, so individuals who are particularly wanted by the system are winnowed out of

the database by using a time consuming process during conditions of light activity.

The employees performing the registration operation identify themselves using biometric-PIC only when initially activating the registration system. This is a convenience for the employee, but a possible security problem for the system, as unattended or "temporarily borrowed" BRTs could be the source for fraud. As a result, the registration application exits after a predetermined period of no activity.

#### 1.4.9. Terminal: Customer Service

##### 1.4.9.1. Purpose

The purpose of the customer service terminal (CST) is to provide internal DPC support personnel access to the various aspects of the system databases. Support people need to answer inquiries by individuals, issuers, institutions, and merchants that are having trouble with the system.

##### 1.4.9.2. Construction

The CST consists of:

- a microcomputer
- an BIA/Int
- ethernet/token ring/FDDI network interface
- a database examination and modification application

Each CST is connected to the system via a high speed local area network connection such as token ring, ethernet, fiber (FDDI), etc. Each CST has the capability to query each of the databases, and display the results of these queries. However, the CST only displays fields and records based on the privilege of the individual terminal user. For instance, a standard customer service employee won't be able to see the encryption code for a given BIA's VDB record, though they can see which merchant or individual currently owns that BIA.

#### 1.4.9.3. Identification

For the CST to allow access to the database, the individual and the BIA must be identified by the system. In addition, the individual's privilege level must also be determined, so that the database can restrict access appropriately.

#### 1.4.9.4. Operation

An individual using a CST starts a session by providing identification by entering their biometric-PIC. The BIA constructs an Identification Request message, and send it to the DPC for verification. Once the system verifies the individual, the CST application can operate normally, though limited by the individual's previously assigned DPC privilege level.

#### 1.4.9.5. Security

For security purposes, the DPC will terminate a connection to the CST application after a predetermined idle time period.

It is important that the database application cannot be modified in any manner; either deliberately, or through an unintentional introduction of a virus. To that end, individual CSTs do not have any floppy drives or other removable media. Furthermore, read access to the database application executable is strictly limited to those with a need to know.

In order to protect the communications between the CST and the database from surreptitious modification or disclosure, the CST encrypts all traffic between the CST and the database. To do this, the CST generates a session key that is sent to the server during the login session with the system. This session key is used to encrypt and decrypt all communications with the DPC that occur during the period.

Even assuming secure communications and no modified database applications, the DPC makes certain that DPC data fields that are not accessible to the individual operating the CST are not sent to the CST's database application. Likewise, at no time do any CST personnel have access to or permission to modify individual biometric information.

The DPC and the support center can be co-located, or because of the fairly tight security surrounding the CST itself, the support center can be split off on its own.

#### 1.4.10. Terminal: Issuer Terminal

##### 1.4.10.1. Purpose

The purpose of the issuer terminal is to allow employees at issuing banks to submit batch asset account modification operations to the DPC in a secure and identifiable manner.

##### 1.4.10.2. Construction

The IT consists of:

- a microcomputer
- a modem, X.25 network, or Internet connection to the system
- an BIA/Iss
- a network connection to the bank's internal network

The Issuer Terminal uses an issuer BIA to authorize mass additions and deletions of financial asset information.

##### 1.4.10.3. Identification

In this operation, the bank must be identified, a properly-authorized bank employee must be identified, and all of the individuals whose asset accounts are being added or removed must also be identified.

The bank is responsible for identifying the individuals who wish to add their accounts at that bank to their asset account list. As in biometric registration, this is done by the bank using signature cards and personal information. The DPC identifies the bank by cross-checking the issuer code submitted by the IT with the issuer code registered in the VAD record of the BIA/Iss. A biometric-PIC is used to identify the bank employee actually submitting the batch.



#### 1.4.10.4. Operation

In order to add a financial asset account, an individual gives his biometric identification number to the bank (the identification number is given to the individual during the initial biometric registration step) along with the accounts that are to be added. After the individual is properly identified, this identification code and account list are forwarded to the IT for subsequent batch submission to the system.

Whenever deemed appropriate by the bank, an authorized individual at the bank instructs the IT to upload the batched account additions/deletions to the DPC. To do this, the authorized individual enters his biometric-PIC, the IT adds a session key, adds the bank's issuer code, and from that the BIA/Iss constructs an Issuer Batch Request message that the IT then forwards to the DPC. The IT encrypts the batch using the message code, and then sends that as well.

When the system receives the Issuer Batch Request, it validates that the BIA is an BIA/Iss, that the BIA/Iss is registered to the bank claimed by the issuer code, and that the individual identified in the biometric-PIC is allowed to submit batch requests to the DPC for that bank. If so, the DPC processes all the requests, keeping track of errors as required. Once done, the DPC returns the individual's private code, along with an encrypted batch containing any errors that occurred during processing.

#### 1.4.10.5. Security

Securing this transaction is critical for the security of the system. A criminal intent on fraud need only find a way to add other people's accounts to his biometric identification code and can then commit fraud at will. Eventually the criminal is caught, and purged from the database, but only after other people's accounts are drained by the criminal.

Encryption guarantees that the transmission between bank and DPC cannot be intercepted, and thus account numbers are protected in transit.

Cross-checking the bank with the BIA/Iss means that both the IT and the BIA must be compromised to submit false add/delete messages

to the DPC. Thus, the bank must ensure that the IT is physically secure, and that only authorized individuals are allowed to access it.

Requiring an individual to submit the batch provides for a responsible human to be "in the loop" whose job it is to make sure that proper bank security measures have been followed in the construction and submission of the batch.

#### 1.4.11. Terminal: Automated Teller Machinery

##### 1.4.11.1. Purpose

The purpose of the biometric ATM is to provide individuals access to cash and other ATM functions without having to use an Interbank card. It does this by submitting a biometric-PIC and an account index code and retrieving a bank account number. For users of the system, this replaces the Interbank card (known in the industry) + PIC mechanism as a method for identifying the account and authorizing the individual. It is assumed that all ATMs still continue to accept Interbank cards.

##### 1.4.11.2. Construction

- a standard ATM
- an integrated BIA/ATM (scanner only)
- a connection to the DPC

The biometric ATM uses an integrated BIA/ATM to identify individuals and allow them access to financial assets using a biometric-PIC and an account index. An BIA/ATM is installed into the ATM, making use of the ATM's current PIC pad for PIC and account index code entry. The ATM is connected to the system using X.25 or modem.

The BIA/ATM is structured in such a way as to make integration with an existing ATM network as simple as possible. This results in a compromise between security and ease of integration.

#### 1.4.11.3. Identification

Three entities need to be identified for the DPC to respond properly to an BIA/ATM account request: the individual, the bank, and the BIA/ATM.

The bank is identified by cross-checking the ATM's stored bank code with the BIA/ATM's bank code. The BIA/ATM is identified by successfully locating the BIA/ATM in the VAD, and the individual is identified through the standard biometric-PIC.

#### 1.4.11.4. Operation

To access an ATM, an individual enters their biometric-PIC into the BIA along with the account index code. The BIA forms an account access request message, which is then sent to the DPC by the ATM. The DPC validates the biometric-PIC as well as the emergency account index code, and then sends the resulting asset account number along with the private code back to the ATM.

The ATM asks the BIA to decrypt the response, and then displays the private code on the ATM's display screen. The ATM also examines the response to see whether or not the individual is performing a standard account access, or a "duress" account access. If a duress account access is indicated, the ATM may provide false or misleading information as to the amounts available to the individual; the specifics of this behavior will vary from ATM to ATM. However, no ATM will ever provide any indication to the individual that a duress transaction is in progress.

#### 1.4.11.5. Security

Messages between the ATM and the DPC are secured by encryption and MAC calculation from the BIA. The MAC means that the ATM cannot change the contents of the message without being detected, and encryption prevents the encrypted part of the message from being disclosed.

Because the BIA/ATM has no LCD or no PIC pad attached, it requires the ATM to provide all the text prompts and to gather all the input

from the individual. This is less secure than if the BIA were performing the operation, but as ATMs are generally physically robust, it can probably be called a wash.

#### 1.4.11.6. Notes

It is between the bank and the individual to specify the behavior of an ATM when the individual indicates he is performing a transaction under duress. A particular bank may choose to limit access, or alter balance information, or a false screen may be displayed. A false screen is a display of data which has been intentionally pre-determined to be inaccurate such that a coercing party will not illegally obtain accurate data about an individual's financial assets. It is beyond the scope of the invention to specify the precise behavior of an ATM under these circumstances.

#### 1.4.12. Terminal: Phone Point of Sale Terminal

##### 1.4.12.1. Purpose

The purpose of the phone point of sale terminal (PPT) is to authorize credit or debit financial transactions from an individual using a specially-equipped telephone to make a purchase from a merchant.

##### 1.4.12.2. Construction

The PPT consists of:

- an BIA/cav
- a rapid-connect digital modem [see the VoiceView patent (known in the industry)]
- a telephone (keypad, earpiece, microphone)
- a microprocessor
- a DSP (digital signal processor)
- a standard telephone line

The PPT accepts biometric identification using an BIA/catv connected to and integrated with a cordless, cellular, or standard telephone.

#### 1.4.12.3. Identification

In order for the DPC to authorize a transaction, both the individual and the merchant must be identified.

To identify an individual, biometric-PIC identification is used.

To identify a phone-order merchant, the merchant and all his phone numbers that individuals will call are registered with the DPC. Thus when an individual submits an authorization, he also submits the phone number he called, which is then cross-checked with the merchant's listed phone numbers.

#### 1.4.12.4. Operation

Individuals call merchants that are selling their wares through paper catalogs, newspapers, magazines, or other basic print media mechanisms. The PPT uses a special modem that shares the telephone voice line to exchange digital information with the merchant.

Each time the individual makes a phone call, the PPT keeps track of the phone number that was typed by the user, in case the individual decides to make a purchase. A DSP is used to detect dialtone, ring, connection, and so on, in order to tell what the actual phone number entered was, as distinct from extensions, or the navigation of phone message systems, and so on.

Once a call is placed to a merchant, the salesman for the merchant digitally downloads all the relevant information to the PPT including product, price, and the merchant code. Note that when in operation, the modem disconnects the speaker.

When the product information is downloaded, the PPT then prompts the individual for the biometric-PIC, the account index code, and then asks the individual to validate the purchase amount. Then the phone number and the merchant code are added, and the message is encrypted.

The rapid-connect modem is again engaged to send the authorization information to the merchant.

When the merchant receives the authorization information, the merchant verifies that the price and product information are correct, and then forwards the transaction to the DPC using a secured communications channel using either the Internet or some other general purpose network. The connection to the DPC is secured using Public Key Encryption and a secret key exchange.

Upon receiving and decrypting a phone authorization, the DPC checks the phone number against the merchant code, validates the biometric-PIC, and then sends the transaction to the credit/debit network for authorization. If authorization succeeds, the DPC appends the buyer's address to the response message and sends the response to the merchant.

The merchant receives the response from the DPC, copies the mailing address, and forwards the message to the individual again via a brief session with the rapid-connect modem. When the transmission to the IPT is complete, a chime sounds, the modem disconnects, and the individual's private code (decrypted by the BIA) is displayed on the LCD screen. The merchant's sales rep confirms that the individual's mailing address is valid; if so, the call is terminated and the transaction is complete.

#### 1.4.12.5. Security

One of the security concerns about phone transactions is the security of the phone system itself. Apart from the biometric identification, the central problem is making sure that the number the individual called actually reaches the merchant in question.

Note that the communications link between the PPT and the merchant isn't secured, so a purchase authorization from an individual to a merchant could be intercepted. However, no financial benefit would result from this, so it is not deemed to be important.

The security of a PPT is relatively low by necessity of price, weight, and because of the problems inherent in splitting the responsibility of PIC entry and private code decryption and presentation.

### 1.4.13. Terminal: Cable-TV Point of Sale

#### 1.4.13.1. Purpose

5 The purpose of the CATV point of sale terminal (CPT) is to authorize credit or debit financial transactions from an individual in front of his television (or "TV") set to a merchant who is presenting objects for sale on television.

#### 10 1.4.13.2. Construction

The CPT consists of:

- a BIA/catv
- a television remote control with integrated BIA/catv
- 15 • a Cable-TV digital signal decoder
- a Cable-TV remote control reader
- an on-screen display mechanism
- access to a Cable-TV broadband two-way communications channel

20 The CPT accepts biometric identification using an BIA/catv that is integrated with the television's remote control device. The remote control communicates with a television top box that itself communicates with the broadband cable television network. The terminal consists of the television remote logic that communicates with the BIA, as well as the

25 television top box that communicates over the cable broadband network.

#### 1.4.13.3. Identification

30 In this transaction, the merchant and the individual must both be identified to execute the transaction.

The individual is identified by the biometric-PIC.

The merchant is identified by a merchant credential, created by the CATV broadcaster at the time the product is shown on television.

35 Each product broadcast has a merchant-product credential consisting of a merchant code, a time, a duration, and a price which is signed using Public

Key Encryption and the CATV network broadcaster's private key. This merchant-product credential can only be generated by the network broadcaster.

#### 1.4.13.4. Operation

As a television advertisement, an infomercial, or a home shopping channel displays a product, the Cable television network also broadcasts simultaneous digital information that describes a short description, price, as well as the merchant-product credential. This digital information is processed and temporarily stored by the CPT, ready to be accessed by the individual when a decision to purchase is made.

To buy something that is currently being displayed, the individual selects the on-screen display function of the special television Remote, which instructs the CPT to display text information on the screen regarding the currently viewed product.

The individual is first prompted for the number of the items he wishes to buy through the on-screen display. Then he is prompted to enter his Biometric-PIC, and his account index code. Once he verifies that the final purchase price is okay, the product, price, merchant code, merchant-product credential, and channel number along with the Biometric-PIC are used to construct a Remote Transaction Authorization request message. The request is sent to the merchant for authorization by way of the Cable-television broadband two-way communications channel.

Note that each merchant that desires to sell products in this manner must have the ability to receive order information using the broadband Cable television network.

Upon receipt of the authorization request, the merchant submits it to the DPC using a secured Internet connection or an X.25 connection.

If the DPC authorizes the transaction, it constructs an authorization response that includes the current mailing address of the individual in addition to the authorization code, and the encrypted private code. Once the merchant receives the authorization, he copies the authorization and the mailing address, and then forwards the authorization back to the CPT, who then displays the private code to the individual, terminating the transaction.



#### 1.4.13.5. Security

5 This architecture does not allow criminals to replay messages intercepted from the CableTV broadband, but they are able to read parts of them. If this is not desirable, then the messages may be encrypted using an optional CATV Center's public key, or other "link level" encryption between the CATV set-top box (known in the industry) and the CATV local office.

10 To secure a connection between a merchant and the DPC, the connection uses a session key changed daily that has been previously exchanged using a public key encryption key exchange system.

### 1.5. System Description: Data Processing Center

#### 1.5.1. Introduction

15 The Data Processing Center (DPC) handles financial transaction authorizations and individual registration as its main responsibilities. In addition, the DPC provides storage and retrieval for secure faxes, electronic documents, and electronic signatures.

20 Each DPC site is made up of a number of computers and databases connected together over a LAN (known in the industry) as illustrated in the DPC Overview Figure (number\*\*). Multiple identical DPC sites ensure reliable service in the face of disaster or serious hardware failure at any single DPC site. Furthermore, each DPC site has electrical power backup and multiple redundancy in all of its critical hardware and database systems.

25 DPC components fall into three categories: hardware, software, and databases. Below is a short description, by category, of each component. More detailed descriptions appear in the following sections.

#### 1.5.1.1. Hardware

- FW Firewall Machine: the entry point of the DPC site.
- 5 GM Gateway Machine: the system coordinator and message processor.
- DPCLAN DPC Local Area Network: connects the DPC sites

#### 1.5.1.2. Databases

- IBD Individual Biometric Database: identifies individuals from their biometric and PIC code.
- 15 PFD Prior Fraud Database: lists individuals who have defrauded the system and can check if a biometric matches any of these individuals.
- 20 VAD Valid Apparatus Database: stores information required to validate and decrypt BIA messages.
- AOD Apparatus Owner Database: stores information about the owners of BIA devices.
- 25 ID Issuer Database: identifies issuing banks that participate with the system.
- 30 AID Authorized Individual Database: stores the list of individuals allowed to use personal or issuer BIA devices.
- RMD Remote Merchant Database: stores information necessary to process transactions with telephone and cable television merchants.
- 35

EDD Electronic Document Database: stores electronic documents, such as faxes and electronic mail, for retrieval by authorized individuals.

5

ESD Electronic Signature Database: stores electronic document signatures for verification by a third party.

#### 1.5.1.3. Software

10

MPM Message Processing Module: handles the processing of each message by coordinating with the other software modules and databases required to perform the message's task.

15

SNM Sequence Number Module: handles DUKPT sequence number processing.

MACM Message Authentication Code Module: handles MAC validation and generation.

20

MDM Message Decrypt Module: handles encrypting and decrypting of BIA requests and responses.

25

PGL PIC Group List: handles the lookup of PIC groups by PIC and the configuration of database elements that depend on the list of PIC groups.

30

IML IBD Machine List: handles the lookup of the main and backup database machines dedicated to holding IBD records for a given PIC group.

#### 1.5.1.4. Terminology

When defining database schema, the following terminology is used for describing field types:

5

10

int<X>	an integral type using <X> bytes of storage
char<X>	a character array of <X> bytes
text	a variable length character array
<type>[X]	a length <X> array of the specified type.
time	a type used for storing time and date
biometric	a binary data type used for storing the biometric
fax	a binary data type used for storing fax images

15

When describing database storage requirements, the term "expected" means the expected condition of a fully loaded system.

#### 1.5.2. Protocol Description

20

Terminals accomplish their tasks by sending request packets to a DPC site. The DPC site sends back a reply packet containing the status on the success or failure of the request.

25

Communication is via a logical or a physical connection—oriented message delivery mechanism such as X.25 connections, TCP/IP connections, or a telephone call to a modem bank. Each session holds the connection to the terminal open until the DPC sends its response back to the terminal.

The request packet contains a BIA message part and a terminal message part:

30

BIA message part  
 protocol version number  
 message type  
 4-byte BIA Identification  
 4-byte sequence number  
 <message specific data>  
 Message Authentication Code (MAC)

35

Terminal message part  
<terminal specific data>

5 The BIA message part is constructed by an BIA device. It includes one or two biometrics, a PIC, authorization amounts, and the contents of the general registers which are set by the terminal. Note: the MAC in the BIA message part only applies to the BIA part and not to the terminal part.

10 A terminal may place additional data for the request message in the terminal message part. The BIA provides a message key to allow the terminal to secure the terminal part data. The BIA automatically includes the message key in the packet's encrypted biometric-PIC block when necessary. The terminal performs the message key encryption itself, however.

15 The response packet contains a standard header and two optional free-form message parts: one with a MAC and one without:

Standard Header

20 protocol version number  
message type

Optional Free-form message part with MAC

<message specific data>

MAC

25 Optional Free-form message part without MAC

<additional message specific data>

30 The message part with a MAC is sent to the BIA so that it may validate that this part of the response has not been tampered with and to display the individual's private code. The message part without a MAC is used for transmitting large amounts of data, such as fax images, that are not sent to the BIA for MAC validation as the BIA to terminal connection may be of limited bandwidth.

### 1.5.3. Processing Packets

5 In an embodiment of the invention with multiple DPC sites, a terminal need only send its request to one of the DPC sites, typically the closest, because that site automatically handles updating the others by running distributed transactions as necessary.

10 When one of the DPC's Firewall Machines receives a packet, it forwards it to one of the GM Machines for the actual processing. Each GM has a Message Processing Module that handles the coordination between the DPC components required to process the request and sends the response back to the sender.

### 1.5.4. Validating and Decrypting Packets

15 All packets the DPC receives, with the exception of those not constructed by an BIA, contain an BIA hardware identification code (the BIA Identification of the packet), a sequence number, and a Message Authentication Code (MAC). The GM asks the MAC Module to validate the packet's MAC and then checks the sequence number with the Sequence  
20 Number Module. If both check out, the GM passes the packet to the Message Decrypt Module for decryption. If any one of the checks fail, the GM logs a warning, terminates processing for the packet, and returns an error message to the BIA device.

25 Currently, the only message types that are not constructed by an BIA is the Secure Fax Data request and Electronic Document Data request.

### 1.5.5. Reply Packets

30 Each packet the DPC receives may contain an optional response key stored in the encrypted biometric-PIC block of the packet. Before the DPC replies to a request that includes a response key, it encrypts the reply packet with the response key. It also generates a Message Authentication Code and appends it to the packet.

35 The only exception to encrypting response packets applies to error messages. Errors are never encrypted and never include confidential

information. However, most response packets include a status or reply code that can indicate whether the request succeeded or not. For example, when the DPC declines a credit authorization, it does not return an error packet, it returns a normal transaction response packet with a reply code set to "failed".

#### 1.5.6. DPC Procedures

The DPC has two procedures commonly used while processing requests.

##### 1.5.6.1. Individual Identification Procedure

For requests that require the DPC to identify an individual, the DPC executes the following procedure: using the PIC code, the DPC searches the IBD Machine List for the main and backup IBD machines responsible for handling identifications for the given PIC code. Next, the DPC sends the identification request to either the main or backup machines depending on which is the least loaded. The IBD machine responds with the IBD record for the individual or an "individual not found" error.

The IBD machine retrieves all the IBD records for the given PIC. Using a proprietary biometric hardware device, the IBD machine compares each record's primary biometric with the individual's biometric arriving at a comparison score indicating the similarity of the two biometrics. If no biometric has a close enough comparison score, the comparisons are repeated using the secondary biometrics. If none of the secondary biometrics have a close enough comparison score, then the IBD machine returns an "individual not found" error. Otherwise, the IBD machine returns the full IBD record of the individual, from which such fields such as the private code, account numbers, titles, and so on may be obtained.

##### 1.5.6.2. Emergency Response Procedure

For requests that include an account index, the DPC handles the case where the individual chooses his or her emergency account index. The

GM processing the request immediately notifies the DPC customer support staff, logs a warning, and if the response packet has a reply code, sets it to "emergency". It is the responsibility of the owner of the BIA device that submitted the request to watch for an "emergency" reply code and provide further assistance, such as the false screen mechanism described in the ATM terminal section. The DPC also increments the emergency use count of the individual's IBD record whenever the emergency account index gets accessed.

### 1.5.7. Protocol Requests

The following sections describe each protocol request/response and the actions the DPC takes to perform them.

The list of protocol packets are:

- Individual Identification
- Transaction Authorization
- Registration
- Account Access
- Issuer Batch
- Secure Fax Submit
- Secure Fax Data
- Secure Fax Tracking
- Secure Fax Retrieve
- Secure Fax Reject
- Secure Fax Archive
- Secure Fax Contract Accept
- Secure Fax Contract Reject
- Secure Fax Organization Change
- Electronic Document Submit
- Electronic Document Data
- Electronic Document Tracking
- Electronic Document Retrieve
- Electronic Document Reject
- Electronic Document Archive



- Electronic Document Archive Retrieve
- Electronic Signature
- Electronic Signature Verify
- Network Credential

5

#### 1.5.7.1. Individual Identification

##### Individual Identification Request

###### *BIA Part:*

10

4-byte BIA Identification

4-byte sequence number

*encrypted(DUKPT key) Biometric-PIC block:*

300-byte authorization biometric

4-12 digit PIC

15

56-bit response key

MAC

*Terminal Part: (not used)*

##### Individual Identification Response

20

*encrypted(response key):*

private code text

individual name

biometric identification code

MAC

25

30

The Individual Identification request includes a biometric-PIC block which the DPC uses with the individual identification procedure to identify the individual. If the individual is identified, then the DPC responds with the individual's name, biometric identification, and private code. Otherwise, the DPC responds with an "unknown individual" error.

### 1.5.7.2. Transaction Authorization

#### Transaction Authorization Request

##### *BIA Part:*

5           4-byte BIA Identification  
           4-byte sequence number  
           *encrypted(DUKPT key) Biometric-PIC block:*  
             300-byte authorization biometric  
             4-12 digit PIC  
 10           56-bit response key  
             [optional 56-bit message key]  
           account index  
           price  
           merchant Identification  
 15           [optional free-format product information]  
           [optional merchant code (phone#, channel# + time, hostname)]  
           [optional send-address request]  
           MAC

##### *Terminal Part: (not used)*

20

#### Transaction Authorization Response

*encrypted(response key):*  
           private code text  
           authorization response  
 25           authorization detail (autho code, transaction identification, etc)  
           [optional individual address information]  
           reply code (fail, ok, emergency)  
           MAC

30

There are two basic transaction authorization subtypes: retail and remote.

For retail authorizations, the DPC identifies the purchasing individual by the biometric-PIC block of the request. If the individual cannot be identified, the DPC replies with an "unknown individual" error.

35

Next, the DPC sends an external authorization request (crediting the asset account of the BIA device's owner and debiting the

individual's asset account) to one of several existing financial authorization services depending on the type of asset accounts involved (such as Visa™ or American Express™). If the external financial authorization service approves the transaction, the DPC returns the external authorization codes and an "ok" reply code to the BIA device. Otherwise, the DPC returns the reason why the authorization was denied and sets the reply code to "failed". In either case, the DPC includes the individual's private code in the response.

When the DPC looks up the individual's asset account using the account index of the request, the chosen account may be the "emergency" account. If this happens, the DPC follows the emergency response procedure. The external authorization still takes place, however.

Remote authorization are generated by telephone, mail-order, or cable television merchants. The DPC handles remote authorizations the same way it does a retail authorization but with the following exceptions:

i) Remote authorizations include a remote merchant code which the DPC checks against the Remote Merchant Database to validate whether the packet's merchant Identification matches the one stored in the database. Furthermore, the asset account credited is the remote merchant's account, not the account of the BIA device's owner.

ii) Additionally, BIA devices that generate the remote authorizations tend to be personal BIA devices. The DPC checks the biometric Identification of the identified individual against the Authorized Individual Database's list of individuals allowed to use the BIA device. If the individual is not authorized to use the device, then the DPC denies the authorization request.

iii) Finally, the authorization packet may contain a "send-address" indicator. This indicator informs the DPC to include the individual's address in the reply packet and is usually used only for mail order purchases.

### 1.5.7.3. Registration

#### Registration Request

##### *BIA Part:*

- 4-byte BIA Identification
- 4-byte sequence number

*encrypted(DUKPT key) Biometric-PIC block:*

1000-byte primary biometric

1000-byte secondary biometric

4-12 digit PIC

5 56-bit response key

56-bit message key

MAC

*Terminal Part:**encrypted(message key):*

10 name

address

zipcode

private code

asset account list (account index code, account #)

15 emergency account (account index code, account #)

title list (title index code, title name)

**Registration Response**

status code

20 *encrypted(response key):*

private code text

PIC

biometric Identification code

list of DPC chosen PICs (if original choice of PIC

25 is rejected)

status code (ok, rejected)

MAC

30 Individuals register with the DPC via a Biometric Registration Terminal (BRT). The BRT sends the DPC a registration packet containing primary and secondary biometrics and personal identification code, along with ancillary data such as the individual's name, address, a list of financial asset accounts, the private code, and the emergency account. Optionally, the individual may include an electronic mail address, and a title list

35 including titles and the title index code, as well as an Social Security Number (or "SSN"). The individual may choose his or her own PIC code

or allow the system to choose it. In a modification step any previously entered data can be modified or deleted.

At any given moment, only one DPC site acts as the registration site, for implementation simplicity. Registration request packets received by non-registration DPC sites are forwarded to the current registration site. The registration DPC site performs the entire registration check, assigning of IBD records to IBD machines, and the distributed transaction required to update all other DPC sites.

The registration DPC site selects the PIC code for registration requests that don't specify one, stores the IBD record on the main and backup IBD machines (as specified in the PIC Group List), and checks the PIC and biometric suitability of the registration packet before running the distributed transaction to update the other DPC sites.

The DPC runs a personal identification code and biometric sample duplication check step wherein the biometrics and personal identification code gathered during the registration step is checked against all previously registered biometrics currently associated with the identical personal identification code. The DPC may reject the registration for the following reasons: the PIC code is too popular, or the biometrics are too similar to other biometrics stored under the chosen PIC. To aid the individual in choosing an acceptable PIC, the DPC generates a short list of PIC codes for which the registration will be guaranteed that it reserves for a period of time. The BRT then prompts the individual for a new PIC which may be chosen from the good PIC list.

#### 1.5.7.4. Account Access

##### Account Access Request

###### *BIA Part:*

4-byte BIA Identification

4-byte sequence number

*encrypted(DUKPT key) Biometric-PIC block:*

300-byte authorization biometric

4-12 digit PIC

56-bit response key

[optional 56-bit message key]

account index

MAC

*Terminal Part: (not used)*

5

#### **Account Access Response**

*encrypted(response key):*

private code text

[optional PIC]

asset account number

10

reply code (fail, ok, emergency)

MAC

15

The account access request allows BIA-equipped Automated Teller Machines to provide a safer and more convenient way for individuals to identify themselves to the ATM.

The GM identifies the individual by the packet's biometric-PIC and uses the specified account index to choose which asset account number to retrieve.

20

When the GM looks up the individual's asset account using the account index of the request, the chosen account may be the "emergency" account. If this happens, the GM follows the emergency response procedure.

25

#### **1.5.7.5. Issuer Batch**

##### **Issuer Batch Request**

*BIA Part:*

4-byte BIA Identification

4-byte sequence number

30

*encrypted(DUKPT key) Biometric-PIC block:*

300-byte authorization biometric

4-12 digit PIC

56-bit response key

56-bit message key

35

issuer code

MAC

*Terminal Part:**encrypted(message key) batch list:*

add <biometric Id> <account index> <asset account> [<emergency flag>]  
 remove <biometric Id> <account index> <asset account>

**Issuer Batch Response***encrypted(response key):*

private code text

reply code (fail, ok, emergency)

MAC

*encrypted(message key) failed list:*

failed &lt;command&gt; &lt;code&gt;

...

The Issuer Batch request allows an issuing bank or other authority to perform routine maintenance on the Individual Biometric Database. The DPC logs a security violation warning if it receives any Issuer Batch requests from non-issuer BIA devices, and it also refuses to process the request.

The DPC identifies the individual submitting the batch request by following the individual identification procedure. The DPC then checks that the individual is registered in the Authorized Individual Database to use the BIA device embedded in the sending Issuer Terminal.

The DPC also uses the issuer code in the request to look up the apparatus owner Identification in the Issuer Database and compare it against the apparatus owner Identification stored in the Valid Apparatus Database to ensure that the issuer code is not forged.

The DPC then executes the add and delete commands in the message-key encrypted batch list. The batch list is a newline separated list of commands. Valid commands are:

add <biometric Id> <account index> <asset account> [<emergency flag>]  
 remove <biometric Id> <account index> <asset account>

The add command adds the asset account to the account list at the specified account index. The optional emergency flag indicates whether the particular account index is treated as the individual's emergency account. If the

asset account currently stored in the account list does not belong to the issuer, the command fails. This feature prevents one bank from adding or removing asset accounts from other bank's customers without the individual's knowledge or authorization.

5           The remove command clears the individual's asset account stored at the specified account index in the account list. If the asset account currently stored in the account list does not match the account the issuer is attempting to remove, the command fails.

10           For each command in the batch that failed to execute correctly, the GM logs a security violation warning and appends an entry to the failed list of the response. The failed entry includes the text for the command and the error code.

#### 1.5.7.6. Secure Fax Submit

##### Secure Fax Submit Request

###### *BIA Part:*

4-byte BIA Identification

4-byte sequence number

20           *encrypted(DUKPT key) Biometric-PIC block:*

300-byte authorization biometric

4-12 digit PIC

56-bit response key

56-bit message key

25           security mode (unsecured, sender-secured, secured, secured-confidential)

sender title index code

sender fax number

sender fax extension

recipient list

30           [optional archive fax indicator]

[optional contract/agreement indicator]

*Terminal Part: (not used)*



**Secure Fax Submit Response***encrypted(response key):*

private code text

fax tracking number

MAC

When the DPC receives a Secure Fax Submit request, it identifies the individual from the request's biometric-PIC by following the individual identification procedure. This identification, along with the individual's title described by the title index code, is presented to the recipients so that the sender of the fax is always reliably identified.

The DPC generates a tracking number for tracking purposes and stores it, the sender's biometric Identification, the security mode, and the message key in a newly created EDD Document record. For each recipient in the recipient list, the DPC also creates a Recipient record. The DPC then waits for the sending fax machine to transmit the fax data encrypted under the message key.

If the request includes an "archive fax" or "contract/agreement" indicator, the EDD places a copy of the Document and Recipient records in the archive database. Any subsequent updates to these records are also made to the archived versions.

The fax data is sent in a separate step so that if the sender makes a mistake entering his biometric and PIC, the system notifies him before he wastes any time feeding the document into the fax machine.

**1.5.7.7. Secure Fax Data****Secure Fax Data Request***BIA Part: (not used)**Terminal Part:*

fax tracking number

*encrypted(message key):*

fax image data

**Secure Fax Data Response**

status (incomplete, ok)

The Secure Fax Data request allows a secure fax machine to send the fax image to the DPC for delivery to the previously specified recipient(s). This request does not involve any biometric identification and instead relies upon the secret message key to securely transmit the image.

5           The fax image data is encrypted by the message key registered by the Secure Fax Submit request. Once the DPC has received the entire fax, it sends a Secure Fax Arrival Notice message to each of the recipient's fax numbers. The DPC retrieves the list of recipients by querying the EDD for all Recipient records containing the fax tracking number. The Recipient record  
10           contains the destination fax number and optional extension. After sending the Arrival Notice, the DPC updates each Recipient record's delivery status field to "notified". Note: if the destination fax number is busy, the DPC marks the delivery status field to "busy" and retries sending the notice periodically (i.e., every 10 minutes) until successful and at that time, updates the status field to  
15           "notified".

The Arrival Notice is as follows:

Secure Fax Arrival Notice (Fax message)

sender name, company, title, and fax number

20           fax tracking number

instructions on how to download the fax

The DPC only sends the sender a Status Notice via fax after all recipients have either retrieved or rejected the fax. The sender may query the  
25           DPC using the Secure Fax Tracking request (see below) to get the current status of all recipients.

The Status Notice is as follows:

Secure Fax Status Notice (Fax message)

30           sender name, company, title, and fax number

fax tracking number

list of recipients showing:

name, company, title, and fax number

delivery date and status

35           contract/agreement status

The DPC finds each individual's company and title information in the EDD Organization table.

For individuals who are not registered in the system and hence cannot receive secure faxes or for non-recipient secured modes, the DPC does not send them a Secure Fax Arrival Notice. Instead, the DPC sends them the fax directly. If the fax line is busy, the DPC retries every 10 minutes until it succeeds in delivering the fax.

#### 1.5.7.8. Secure Fax Tracking

##### Secure Fax Tracking Request

###### *BIA Part:*

4-byte BIA Identification

4-byte sequence number

*encrypted(DUKPT key) Biometric-PIC block:*

300-byte authorization biometric

4-12 digit PIC

56-bit response key

56-bit message key

fax tracking number

MAC

*Terminal Part: (not used)*

##### Secure Fax Tracking Response

*encrypted(response key):*

private code text

message digest for tracking response fax image

status code (ok, failed)

MAC

fax image for recipient status list

The DPC handles the Secure Fax Tracking request by retrieving all EDD Recipient records for the fax and generating a fax message to display the records. If the individual making the tracking request is not the sender of the fax document, then the DPC sets the status code to failed and puts an empty fax in the response.

The tracking response fax contains information describing the status of the delivery of the fax to each recipient. This fax contains such status information as line busy, fax arrival notice sent, fax sent, fax rejected, contract accepted, and so on.

5

The Tracking Notice is as follows:

Secure Fax Tracking Notice (Fax message)

sender name, company, title, and fax number

fax tracking number

10

list of recipients showing:

name, company, title, and fax number

delivery date and status

contract status

15

#### 1.5.7.9. Secure Fax Retrieve

##### Secure Fax Retrieve Request

*BIA Part:*

4-byte BIA Identification

20

4-byte sequence number

*encrypted(DUKPT key) Biometric-PIC block:*

300-byte authorization biometric

4-12 digit PIC

56-bit response key

25

fax tracking number

MAC

*Terminal Part: (not used)*

##### Secure Fax Retrieve Response

30

*encrypted(response key):*

private code

56-bit message key

status (incomplete, ok, invalid recipient)

message digest for fax image

35

MAC

*encrypted(message key):*

fax image

The DPC uses the biometric-PIC to identify the individual making the retrieve request by following the individual identification procedure. If no EDD Recipient record exists for the individual and for the specified fax, then the DPC responds with an "invalid recipient" status.

The DPC retrieves the encrypted fax image from the EDD Document record with the correct fax tracking number and biometric Identification which it returns to the requester.

The fax image includes a cover page that displays whether the fax is a contract/agreement and the sender's name, company, title, fax number, and extension.

When the last recipient has either received or rejected the fax, the DPC sends a Status Notice via fax (see Secure Fax Data, above) to the fax's sender and then schedules to remove the Document and Recipient records from the EDD within a configurable time period. The time period is intended to allow the recipients sufficient time to decide whether or not to archive the fax.

#### 1.5.7.10. Secure Fax Reject

##### Secure Fax Reject Request

*BLA Part:*

4-byte BLA Identification

4-byte sequence number

*encrypted(DUKPT key) Biometric-PIC block:*

300-byte authorization biometric

4-12 digit PIC

56-bit response key

fax tracking number

MAC

*Terminal Part: (not used)*

##### Secure Fax Reject Response

*encrypted(response key):*

private code

status code (ok, invalid recipient)  
MAC

5 The DPC uses the biometric-PIC to identify the individual making the secure fax reject request. The DPC finds the EDD Recipient record keyed by the request's fax tracking number and the individual's biometric Identification. If the record cannot be found then the request fails with an "invalid recipient" status.

10 When the last recipient has either received or rejected the fax, the DPC sends a Status Notice via fax (see Secure Fax Data, above) to the fax's sender and then schedules to remove the Fax and Tracking records from the EDD within a configurable time period. The time period is intended to allow the recipients sufficient time to decide whether or not to archive the fax.

#### 15 1.5.7.11. Secure Fax Archive

##### Secure Fax Archive Request

###### *BIA Part:*

4-byte BIA Identification  
4-byte sequence number  
20 *encrypted(DUKPT key) Biometric-PIC block:*  
300-byte authorization biometric  
4-12 digit PIC  
56-bit response key  
25 fax tracking number  
MAC

###### *Terminal Part: (not used)*

##### Secure Fax Archive Response

30 *encrypted(response key):*  
private code  
status code (ok, invalid individual)  
MAC

35 The DPC uses the biometric-PIC to identify the individual making the secure fax archive request. The DPC finds the EDD Recipient record keyed

by the request's fax tracking number and the individual's biometric Identification. If the record cannot be found and the individual is not the sender or one of the recipients, then the request fails with an "invalid individual" status. Otherwise, the DPC copies the Document and Recipient records into the EDD archive database. Any subsequent changes to these records are also copied to the archived versions.

#### 1.5.7.12. Secure Fax Contract Accept

##### Secure Fax Contract Accept Request

###### *BIA Part:*

4-byte BIA Identification

4-byte sequence number

###### *encrypted(DUKPT key) Biometric-PIC block:*

300-byte authorization biometric

4-12 digit PIC

56-bit response key

fax tracking number

MAC

###### *Terminal Part: (not used)*

##### Secure Fax Contract Accept Response

###### *encrypted(response key):*

private code

status code (ok, invalid recipient)

MAC

The DPC uses the biometric-PIC to identify the individual making the Contract Accept request. The DPC finds the EDD Recipient record keyed by the request's fax tracking number and the individual's biometric Identification. If the record cannot be found then the request fails with an "invalid recipient" status. Otherwise, the DPC updates the Recipient record's contract status field to "accepted" and generates a Status Notice to the fax's sender (see Fax Data, above).